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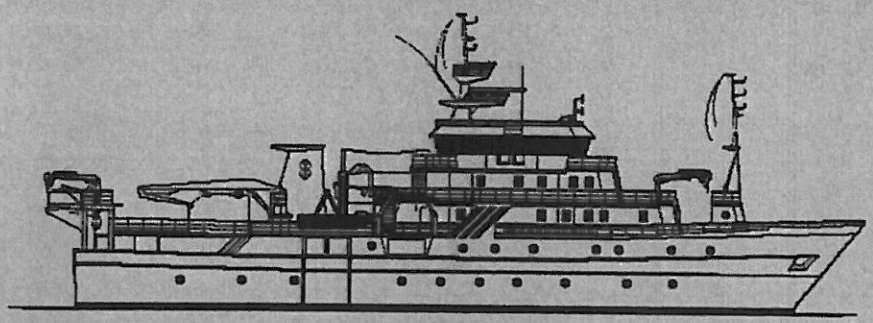
CRUISE REPORTS "DR. FRIDTJOF NANSEN"



SURVEYS OF THE FISH RESOURCES OF NAMIBIA

Cruise Report No 2/96

Part I
Hake survey methodology and ecology
10 April - 1 May 1996

Part II

Abundance estimation and ecology of 0-group hake (*Merluccius capensis*)
2 - 13 May 1996

Ministry of Fisheries & Marine Resources
Swakopmund
Republic of Namibia

Institute of Marine Research
Bergen
Norway

CRUISE REPORT 'DR. FRIDTJOF NANSEN'

SURVEY OF THE FISH RESOURCES OF NAMIBIA

Cruise Report No 2/96

Part I
Hake survey methodology and ecology
10 April - 1 May 1996

by

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Institute of Marine Research
Bergen, 1996

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CHAPTER 1 INTRODUCTION

1.1 Objectives

Part one of the cruise had the following objectives:

- To test and tune a towed instrument platform, the Focus 400.

- To study the behaviour and distribution of relevant fish species, mainly hake, with bearing on assessment methods.

The first objective involved the installation, harbour test and sea test of the Focus 400, as well as user training and preliminary tests with different equipment like light meter, video cameras and photographic cameras, including bottom photography and Focus 400 trawl observations by sonar and video camera.

The second objective was planned to be met by running the Focus along the bottom taking pictures every 30 seconds in order to obtain true distributions and densities of hake and other groundfish against which the efficiency of the trawl could be measured. Also, trawl swept area experiments were to be carried out, and the effect on hake acoustic assessment of the diurnal vertical migration of mesopelagic fish was to be elucidated.

Additional tasks were to measure light in the sea, including bioluminescence, to find if swimbladder gas could represent an oxygen reservoir for the hake (Peter Woodhead, University of New York), and to do comparative fishing with "Welwitchia", equipped with a lighter version of the Gisund Super trawl used by "Dr. Fridtjof Nansen", which is presently considered for use as a standard bottom trawl for "Welwitchia". Observations of trawl functionality were also to be made using the Focus 400.

1.2 Participation

The scientific staff consisted of:

From Namibia:

Filimon DAUSAB (18.04-01.05), Hashali HAMUKUAYA (18.04-01.05), Malakia SHIMANDA (18.04-01.05), Dave BOYER (18-26.04), Sandy DAVIES 18.04-01.05)

From Norway:

Svein FLOEN (11.04-01.05), Ingvar HUSE (11.04-01.05), Tore STRØMME (18.-26.04), Ingvald SVELLINGEN (11.04-01.05), Jan VÅGENES (11.04-01.05), Jan Tore ØVREDAL (11.04-01-05).

Additional participants:

Torben KJÆR-CHRISTENSEN, McArtney (11-16.04), Jens BILTOFT, McArtney (11-18.04), Pierre MALAN (SFRI, Cape Town) (18.04-01.05), Peter WOODHEAD, University of New York (18.03-01.05).

1.3 Narrative

The working areas are shown in Figure 1.

Two days were spent in Walvis Bay installing and testing the Focus 400. The vessel left Walvis Bay with a limited scientific staff and two representatives from McArtney on the afternoon of 13 April and steamed west to carry out the sea acceptance test of the Focus. En route an attempt to observe a trawl haul with the Focus and video camera was made at 50 m depth. The acceptance tests were carried out at around 300 m depth west of Walvis Bay, after which the ship returned to port to pick up the rest of the scientific staff. Reports from the fishing fleet indicated low catches of hake in all areas, and the course was set for an area at around 300 m depth North West of Walvis Bay at S 21°40" and E 12°43" (Figure 1, Work Area I). The first haul here was promising, but later hauls showed quite small concentrations of hake, and the course was set south along the shelf on 20 April. At S 24°25" E 13°40" good concentrations of both species of hake were found, and most of the work under objective 2

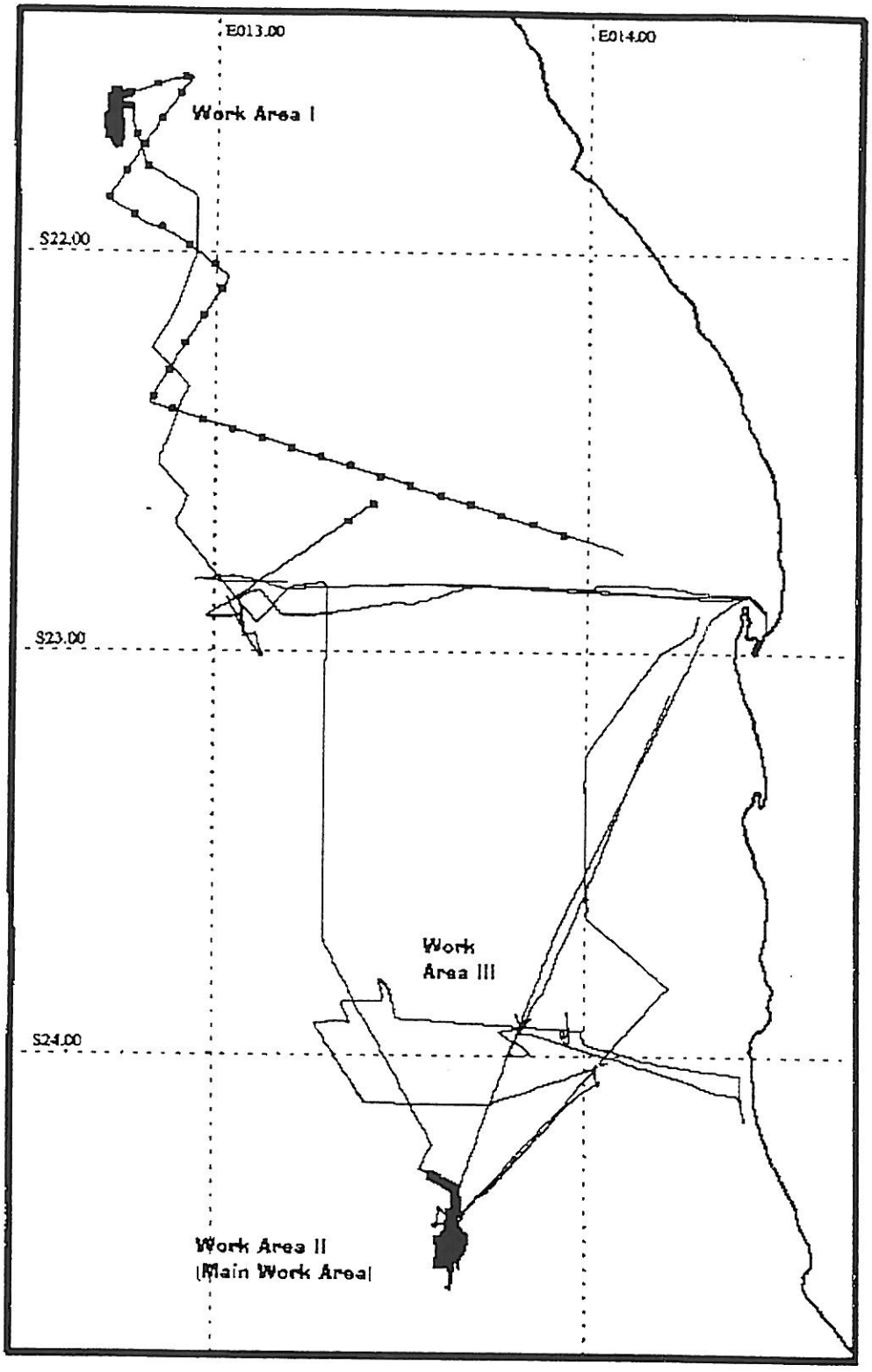

Figure 1. The work areas

was carried out here. Most of the photographic Focus work was abandoned after the results from the northern area, as very little fish was seen on the photographs, and visibility in the sea was limited to less than 4 m at all depths, normally not more than 2m. As a methodical substitute it was decided to carry out vertical trawl sampling to try to identify the diurnal dynamic aspects of the different biological components present, mainly both species of hake, mesopelagic fish, krill and cephalopods. On 26 April the ship called at Walvis Bay to set ashore Boyer and Strømme, and went out again the same afternoon to commence the work. Another unsuccessful attempt at trawl observation was made, and also some attempts at density measurements of horse mackerel schools (Figure 1, Work Area III). 29 and 30 April were spent doing comparative fishing with "Welwitchia" and some experimental swept area studies. The ship returned to Walvis Bay to end this part of the cruise on 1 May.

CHAPTER 2 HYDROGRAPHY

A hydrographical transect of the shelf at the latitude of Walvis Bay taken at the beginning of the cruise is presented in Figure 2. It shows a moderate upwelling situation with the lowest surface temperatures and highest salinities inshore. Bottom oxygen values are also below 0.5 ml/l all the way down to 300 m, with values of around 0.25 ml/l down to 150 m.

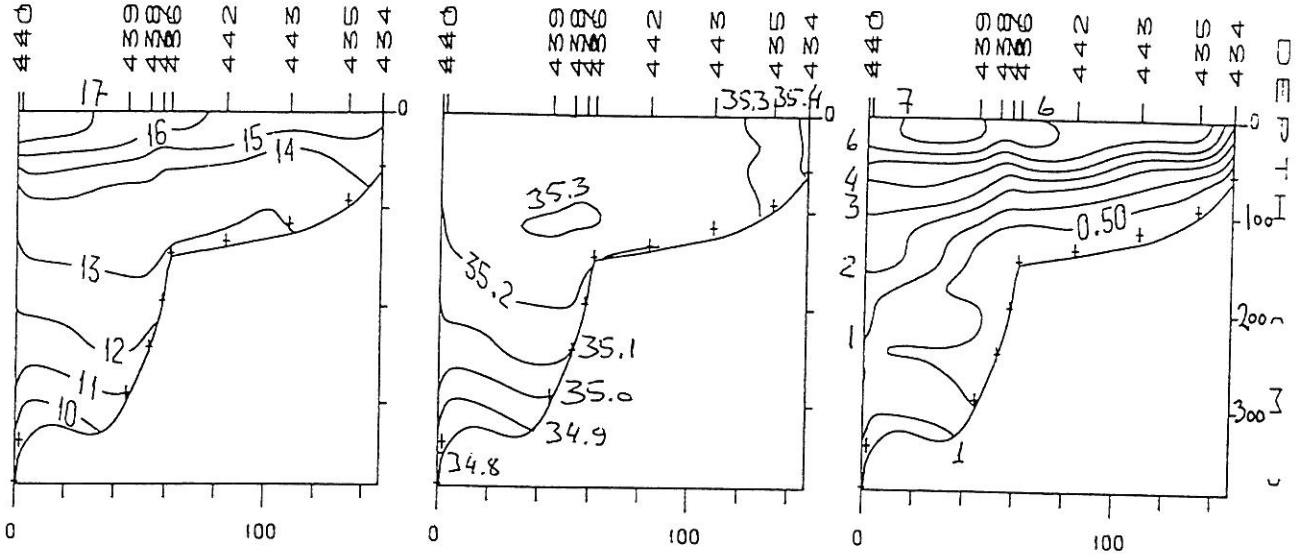

Figure 2. Hydrographic section Walvis Bay - West; temperature, salinity and oxygen.

CHAPTER 3 HAKE SURVEY METHODOLOGY

3.1 Introduction

In Namibian hake bottom trawl surveys all catches are sampled for composition of weights and numbers by species. The bottom trawl has a headline of 31 m (float line), a footrope of 47 m, headline height of 5-6 m and a distance between the wings during towing of about 22 m. All trawl hauls are monitored by SCANMAR trawl sensors (headline height and distance between the doors). This technology allows the determination of the correct trawl bottom time. For conversion of catch rates to fish densities the area between the wings is assumed to be equal to the effective fishing area and the retention factor q is equal to 1. With the new vessel, starting from January 1994, a new trawl gear was introduced with smaller bobbins. For the hake species the new gear is assumed to have no difference in performance. The trawl doors are Thyborøen 7.9 m^2, and the trawl is a simple two panel Gisund Super. The length of a haul over bottom, recorded as distance trawled, is normally measured by log pulses from the GPS, and checked against the lengths of the traces of the hauls on the GPS plot on the MacSea system. Catch data are given in Annex I.

The swept area of a trawl haul is a crucial parameter in swept area survey methodology, particularly if the survey is supposed to estimate total biomass rather than just give a yearly index. Swept distance is easy to measure, while the sweeping width is the difficult parameter. In Namibian hake surveys a swept width of 18.5 m is used. If the assumption for hake is that wing spread is the correct sweeping width, we are in other words overestimating the hake population slightly as the true wing spread is 22 m. Some attempts have been made to find the correct sweeping width for hake, but this is a general problem in swept area assessment methodology all over the world, and the methodological aspects are very complicated, as it is almost impossible to isolate sweeping width as the only parameter involved. The problem consists of assessing how much fish of different species and size groups are herded towards the trawl opening by doors, sand clouds stirred up by the doors, and the bridles which attach the net to the doors, and which are about 50 m long. In addition there is also potential escapement over and under the trawl. No one has yet succeeded in assessing the true efficiency of a trawl gear except in very shallow waters. Still the swept area metodology seems to give the most consistent results for assessing groundfish. Hake definitely seems to

be less herded than e.g. cod in the experiments carried out so far, and perhaps the use of a slightly reduced (18.5 m) swept width in the assessment as opposed to the measured 22 m wing spread compensates adequately for escapement over and under the trawl. Still this problem needs to be further addressed, and in the present cruise a new methodology (on/off bottom, paragraph 3.1.5) was attempted to find the hearding efficiency of doors, sand clouds and bridles.

The problem of mid-water occurrence of hake and its effect on the swept area assessments has been discussed in earlier cruise reports. Mesopelagic fish quite often cover the pelagic zone close to the bottom in the daytime, making it impossible to correct for pelagic hake. Consequently the hake biomass may be underestimated if no correction is made for situations where the pelagic hake distribution is unknown due to shading by mesopelagic fish and plankton. Probably this problem is most pronounced in the north where the acoustic correction to the trawl index constitutes an average of about 10 % addition to the demersal biomass in the day hauls where the conditions allow it to be assessed. In a limited number of night hauls in the January/February survey this year the average corrections were, however, 56, 33 and 43 %. This indicates that the overall corrections would be somewhat higher if daytime acoustic corrections were not made impossible by the presence of mesopelagic fish.

Initially we set out on this cruise to try to define the retention factor or catchability constant q by comparing fish distribution and density from pictures taken by the Focus 400 with trawl catches. But as visibility, and probably fish avoidance of the Focus did not permit us to pursue this methodology, the emphasis was shifted to the behavioural ecology of the hakes and their cohabitants. The objectives then became to describe and if possible explain the diurnal vertical dynamics of the ecosystem, and to assess the problem of acoustic shading of hake by dense layers of mesopelagic fish and plankton. In addition we would test alternative methods to elucidate hake catchability with the sampling trawl.

3.2 Methods

The Focus 400 (Figure 3) is a towed manoeuvrable vehicle with electrical supply for instruments, and fiberoptic transmission of data to and from the ship. It can go down to 400 m and can go out to about 80 m on each side from the course line. It has surface or bottom lock autopilot modes. On this cruise it carried a SIT video camera, a Simrad/Mesotech FS-3300 sonar, a photomultiplier based light meter and a Nikon F4s

photographic camera with a 250 frame automatic backplane in an underwater housing. Kodak Ectachrome 200 film was used and processed on board in an automatic processing machine.

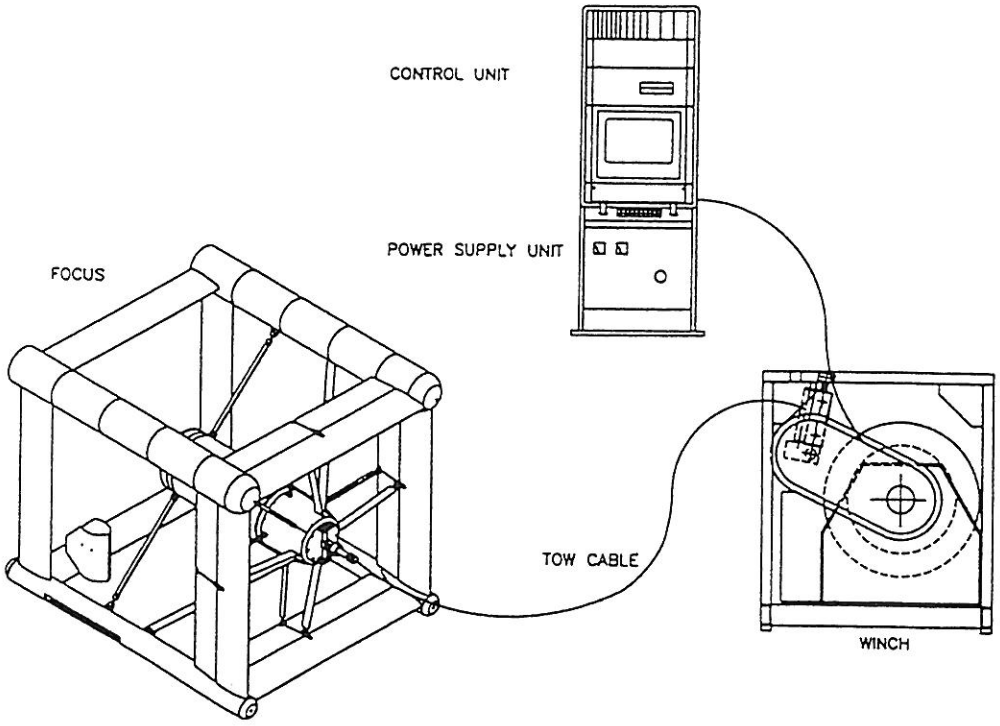

Figure 3. The Focus towed vehicle system.

In the first part of the cruise (Figure 1, Work Area I) the work in each 6 hour watch consisted of one bottom trawl haul, one acoustic coverage and one Focus run 5 m from the bottom, all along the same lane.

In the second area (Figure 1, Work Area II) one bottom trawl haul, one acoustic coverage, and at least one pelagic haul was made along the same lane every 6-hour watch around the clock. The pelagic community was quite distinctly layered both day and night (Figure 2, a and b), and the different layers were sampled with pelagic trawl in an attempt to identify the composition.

The bioluminescense of the pelagic layers could be monitored with the light meter, and could also be readily observed with the SIT video camera. It was possible to follow each layer during the vertical migration on the 38KHz EK500 sounder used. Normal fish samples were taken from all hauls, and stomach content of hake was also observed in many of the hauls.

The swept width methodology studies were aiming at finding a way to minimize the effect of doors, sand clouds and bridles. A promising method tested was to lift the doors about 6 m off bottom. In order to be able to do this without loosing bottom contact with the gear, weights had to be attached to the gear at the wing ends. A few comparisons were made in alternative hauls with the doors on and off bottom. Weights were used in both situations.

3.3 Results and discussion

Technical performance of the Focus 400

All technical acceptance tests with the Focus 400 vehicle were satisfactory apart from a cable winch spooling problem. Operational specifications were met or exceeded, and all interfaces with deployed equipment worked. It was comparatively easy to operate, and the bottom lock auto pilot mode was stable enough on flat bottom to keep a distance of 1.5-2 m at 3 knots. The ROS SIT zoom camera used had a lower light sensitivity than expected, and was significantly less sensitive than an Osprey 1323 with which it was compared. The FS-3300 sonar functioned as expected, but video sync out did not work, so no recordings could be made. The photographic camera worked satisfactory and could be operated both in pre set auto mode and in user real time release mode. The flash gun housing window broke due to a faulty glass, and one flash gun was destroyed, but with a replacement flash gun and glass it worked well. The light meter produced sensible readings down to 10^{-5} lux which corresponds to around 400 m depth in the day-time in the surveyed area at this time of year. It also picked up significant amounts of bioluminescence.

Photography

Altogether nine photographic Focus dives with at least 60 frames shot in each dive were made. After some initial problems the method worked well. Due to the low visibility we were, however, forced to keep a shorter distance to the bottom (3 m) than planned (6 m). This led to a smaller bottom area observed in each shot, and also increased the risk of scaring away large groundfish like hake. And accordingly, in all the hundreds of pictures taken only one hake was observed. This is far below expectancy considering the covered volume and trawl catches in the same area, and strongly indicates an avoidance reaction by the hake. Small bottom dwelling fishes were observed in most pictures, as well as a number of sessile species. The conclusion is that photography from the Focus can not be used as a method to

estimate true densities of hake along the bottom in Namibian waters. It can, however, be used to assess sessile organisms and slow moving fish and crustaceans, but as it still will have to keep a close distance to the bottom the area covered in each shot will be small (<10 m^2).

We also tried to run the Focus close to the bottom with the video camera and lights on. We did see fish and could observe typical flight reactions in burrowing fish. The images were not analysed in detail, but they were asumed to be monk by size, form and behaviour. It could be of value to try a systematic observation to investigate the basis for a monk/sole true density assessment using this technique. If this could be achieved one would also have a method to assess the retention factor for these species in the sampling trawl.

Acoustics

The main working area (Figure 1, Work Area II) was characterised by good concentrations of both hake species and a substantial pelegic component consisting of mesopelagic fish, euphausids and squid. The pelagic component underwent extensive diurnal vertical migration which is examplified in the echograms in Figures 4 (day) and 5 (night). At least 4 layers (5 with the obscured hake layer) were identified during the day and could be followed through diurnal vertical migration where at night the deepest mesopelagic layer split to form 2 sublayers (Figure 5), giving a total of 6 fairly easily discernable and stable layers at night. These were from the surface and down: -one diurnally stable surface layer (L1), 4 vertically migrating mesopelagic layers (L2-L5), and a hake layer (L6) below 300 m. Mean hourly values of total acoustic back-scattering is given in Figure 6. The figure was made from post processed acoustic data, and all acoustic information received during the four diurnal cycles the experiment lasted was combined into one diagram. The six layers can be readily discerned from the combined four day data, illustrating the day-to-day stability of the dynamics. It should also be noted that the light conditions these days were quite stable (Figure 7).

The species composition in the layers was identified from trawl catches (see below). The surface layer (L1) consisted mainly of large medusae and other plankton, and was covered at night by the top mesopelagic layer (L2). The mesopelagic layers (L2-L5) dominated the acoustic backscattering energy in the system, and probably also the biomass. Strangely enough there was no clear cut species separation in the mesopelagic layers despite the distinct separation of the layering. The myctophid fish *Symbolophorus boops* was found in all mesopelagic layers during night-time, totally dominating L2 and L3, still being prominent in

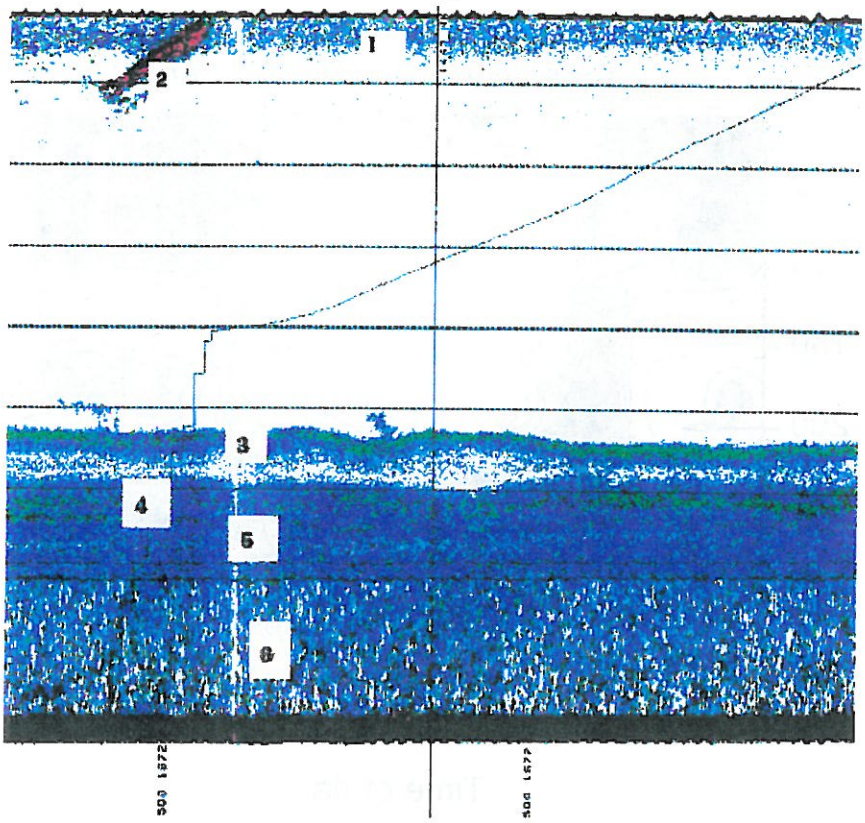

Figure 4. Echogram of acoustic scattering layers in Work Area II in the day-time. 1) Plankton including large medusae; 2) Diving seal; 3)Mesopelagic layer L2; 4)Mesopelagic layers L3 and L4; 5) Hake (L6) within Mesopelagic layer L5; 6) Bottom expansion (10 m)

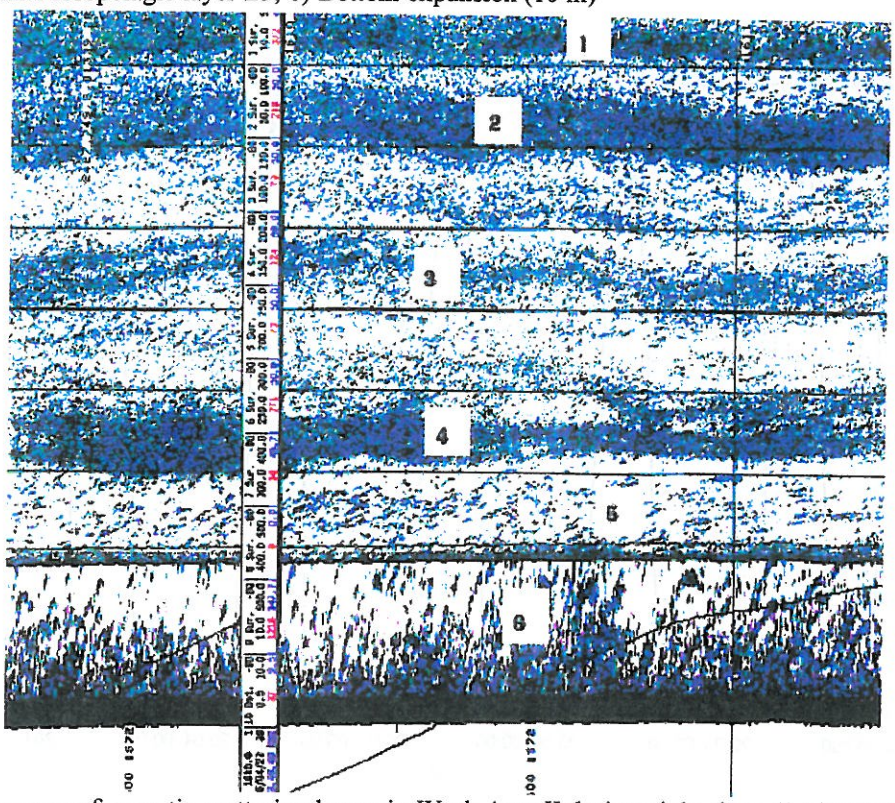

Figure 5. Echogram of acoustic scattering layers in Work Area II during night-time. 1) Plankton layer L1 and mesopelagic layer L2; 3)Mesopelagic layer L3; 4)Mesopelagic layer L5; 5) Hake (L6); 6) Bottom expansion (10 m) showing hake and other ground fish, mainly *Helicolenus dactylopterus*

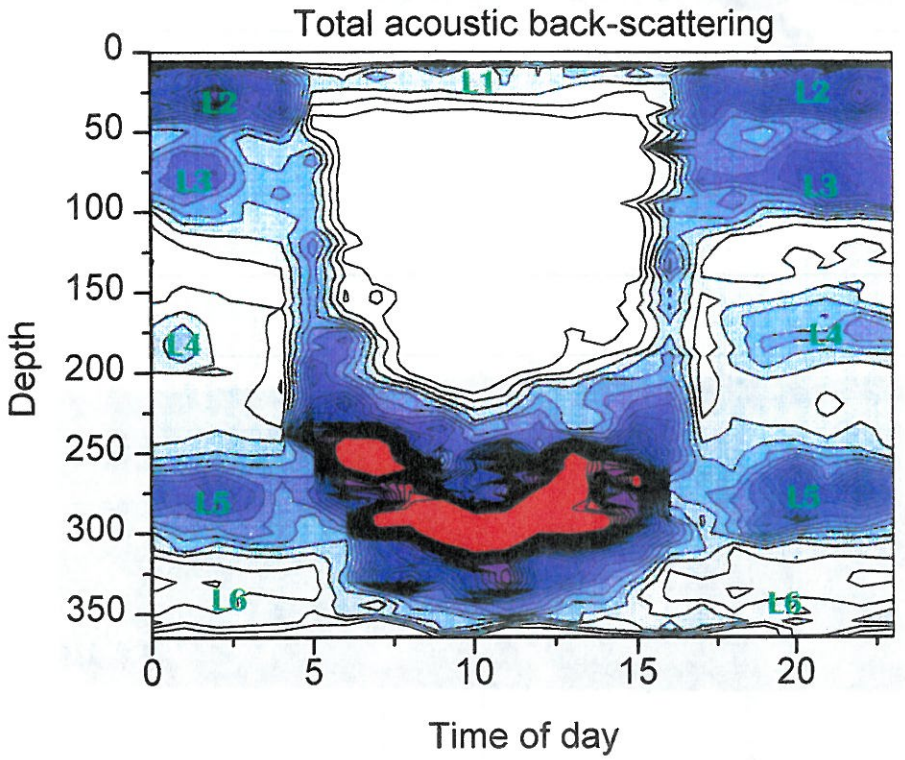

Figure 6. Isoplethe diagram of total acoustic concentrations (S_A values) by depth and time of day. Values are hourly averages of four 24h periods in Work Area II

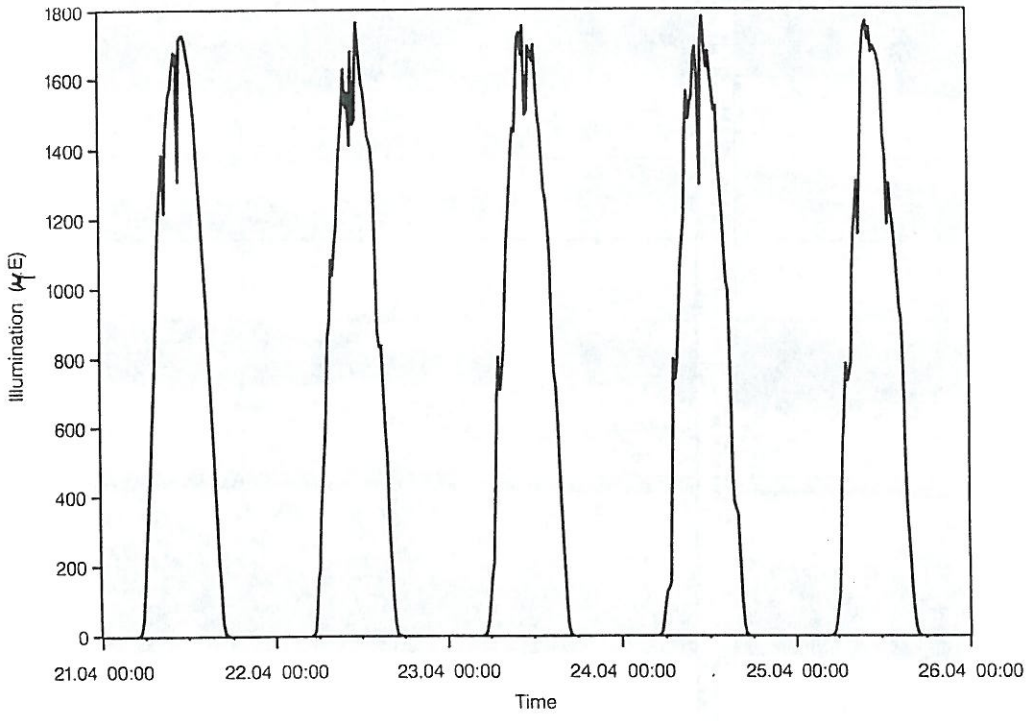

Figure 7. Surface illumination (mE) during the experimental period.

L4, but also being found frequently in L5. On the other hand, the mesopelagic fish *Photichtys argentus* was mainly found in L5 at night, but was also partly and sparingly present in L3 in the early evening. Krill was at night found in layers L3 to L6, but was most abundant in L4. A small (mean weight around 10 g) squid species of the genus *Lycoteuthis* was found in quantities in the order of magnitude of 5% of the total mesopelagic biomass. It migrated from around 230 m in the daytime to L2 and L1 at night. A larger (mean weight of adults >1 kg) squid species of the genus *Todarodes* was less abundant, and stayed generally deeper than the small species in the day-time, but small specimens migrated as high as to L3 in the early evening. Why this mixing of the same species into many layers occur is unclear. It could reflect the feeding motivation or predator avoidance level in the individual fish. Possibly it could also at times reflect by-catch from other layers than the one sampled, particularly in the deeper hauls.

The hake layer (L6, Figure 8) consisted of both species of hake. Acoustic day values were adjusted by trawl catch data and acoustic night values as the hake layer was covered by the other layers during the day. The acoustic observations indicated a certain rise from the bottom at dawn and dusk, and also a most pronounced pelagic distribution in the early evening. It should, however, be noted that this may more reflect the scrutinizing of the echograms than the true distribution. This will be discussed along with the trawl data below.

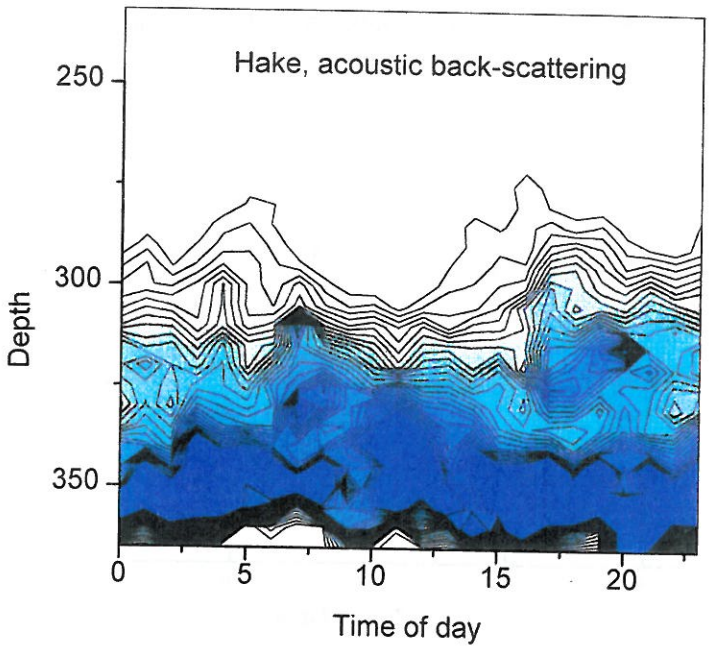

Figure 8. Isoplethe diagram of acoustic concentrations of hake by depth and time of day. Values are hourly averages of four 24h periods in Work Area II

Figure 9 is a presentation of mean hourly acoustic backscattering values over the whole water column. It is dominated by mesopelagic fish, krill and squid. It shows low night values, very low morning- and evening values, and very high daytime values. Figure 10

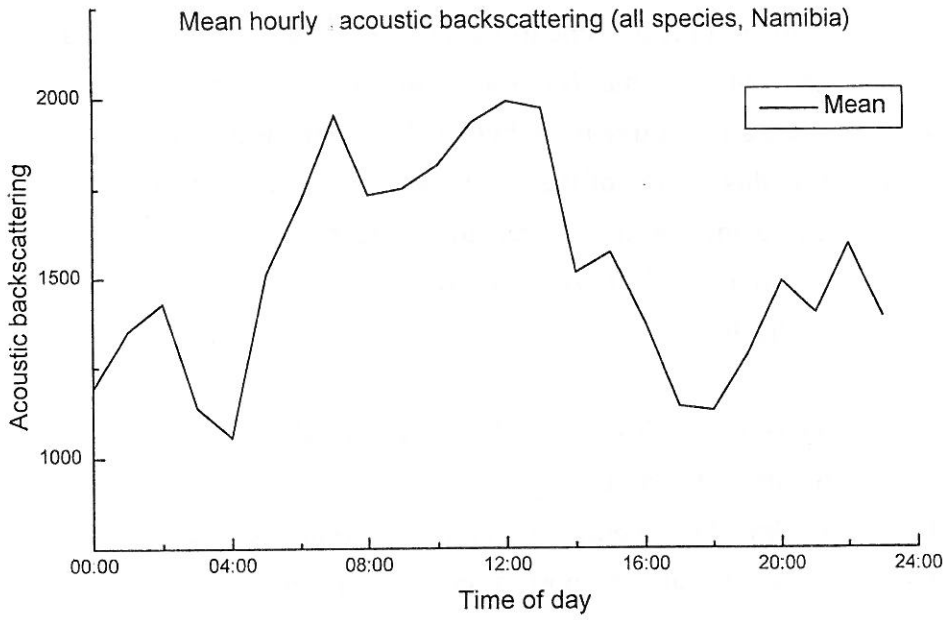

Figure 9. Mean hourly acousticbackscattering for all species (Namibian shelf) for the experimental period.

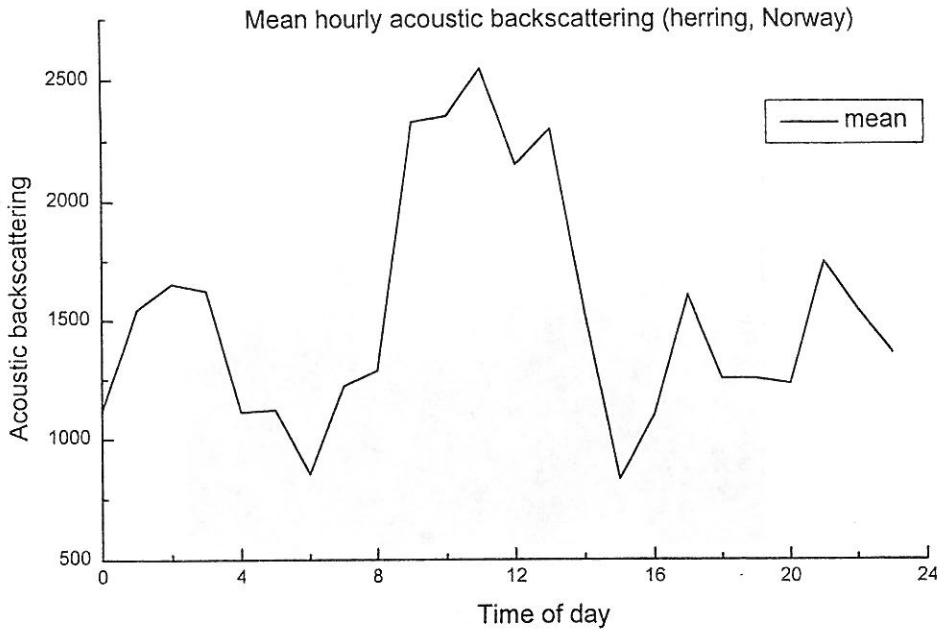

Figure 10. Mean hourly acousticbackscattering for herring during six acoustic assessment surveys in Norway.

shows the same relationship for several years of survey activity for herring in Norway (from Huse and Korneliussen, 1995). The picture there is the same as in the present study. The major difference originates from the fact that the day length is shorter in Northern Norway during winter. Rheinesson et al.(1994) have shown the same characteristics for *Sebastes mentella* in the Irminger Sea between Iceland and Greenland. Generally the curve can be looked upon as a representation of the diurnal variation in acoustic target strength (TS) of the species involved. This is generally modulated by e.g. the tilt angle of the fish (Nakken and Olsen, 1977). The low values at dusk and dawn can therefore be interpreted as being tilt angle induced related to vertical migration. The generally low night values are for herring also caused by tilt angle variations related to an energy saving behaviour pattern (Huse and Ona, 1996). What the cause might be in the present situation is not known, but it may possibly have to do with a more or less constant vertical migration, and a consequent angular articulation of the different components of the biomass measured. It is also noteworthy that in the day-time when the backscattering is strongest the scattering organisms are at their deepest, and consequently, gas filled swimbladders will be most compressed, a situation which should rather minimize reflection. This shows the importance of behaviour in general and tilt angle distribution in particular on acoustic reflection and abundance estimation. The interesting assessment aspect of it all is that if this is a general situation with pelagic fish, the present practice using an average constant TS can give very wrong estimates depending on at what time of day large fish aggregations are encountered. The solution to the problem could be to use dynamic TS functions where the diurnal variation in TS is included. Such functions would, however, have to be modified for different stocks and times of year.

In an acoustic survey situation the best resolution of the hakes will be at night. One way of resolving the issue of hake shading by mesopelagic layers will therefore be to backtrack the survey lane at night when hake surveying is often discontinued anyway due to lower hake catchability in bottom trawl. See also the last part of the next section.

Trawling

Altogether 12 functional bottom hauls and 23 pelagic hauls were carried out during the five days of the special investigation in Work Area II (Figure 1).The time of day and depth of all trawl stations are given in Figure 11. The pelagic hauls were mainly made to elucidate the diurnal hake distribution. Therefore most pelagic hauls were in the hake zone up to 50 m from the bottom, but also the different mesopelagic layers were sampled in order to facilitate

adequate scrutinizing of the echograms. The haul which caught hake highest up in the water column was carried out at 20:00 h, and the fishing depth was 265-290 m, 65-90 m from the bottom. The hake catch in this haul consisted of 4 *M. paradoxus* with a mean weight of 0.35 kg. This was the only haul with hake catches above 300 m, but from 300 m and down both species were found in all hauls. Figures 12 and 13 show total weights of both hake species in bottom and pelagic hauls respectively. Figures 14 and 15 show weights and numbers respectively of *M. capensis* and *M. paradoxus* in bottom trawl hauls. Figures 16 and 17 show the same for pelagic hauls. All catches were standardized to a haul of 1.5 nautical mile at the fishing depth. The total hake weights varied substantially both in bottom and pelagic hauls. Still there was a tendency towards higher day-time than night-time catches in the bottom trawl hauls, while the pelagic hauls with hake catches did not give any strong indications, maybe because they were taken at different depths. In the bottom hauls *M. capensis* biomass dominated over *M. paradoxus* in 10 out of 12 hauls. But the number of *M. paradoxus* were higher than the number of *M. capensis* in all bottom hauls, illustrating the size difference of the two species in this area. *M. paradoxus* catches seemed to be higher in the day-time than at night in the bottom hauls, maybe only signifying that the vast majority of the organisms in the system were pressing against the bottom during the day-time, including the *M. paradoxus*. In 9 of the 11 pelagic hauls with hake catches the M. paradoxus biomass was higher than that of *M. capensis*, and of course also the number of *M. paradoxus* was higher than the number of *M. capensis* in all hauls. This may indicate that the small *M. paradoxus* have to maintain a pelagic position when large *M. capensis* occupy the bottom zone, as smaller hake is an important food source for large *M. capensis* (Payne et al. 1987; Punt et al.1992). Alternatively, young *M. paradoxus* feed on prey organisms which stay more pelagic than the prey of large *M. capensis*. This will be discussed further under 3.1.3.5.

The consequece of all of this in a survey situation is that if only a bottom haul is made in a situation where both species are mixed, both the fraction and the numbers of *M. paradoxus* will be underestimated as the mix normally will consist of large bottom dwelling *M. capensis* and smaller more bathypelagic *M. paradoxus*. Accordingly, when there is the likelyhood of a mix, both a bottom and a deep pelagic haul should be made, e.g. by doing the pelagic hauls at night when the survey activities are often discontinued anyhow (see above).

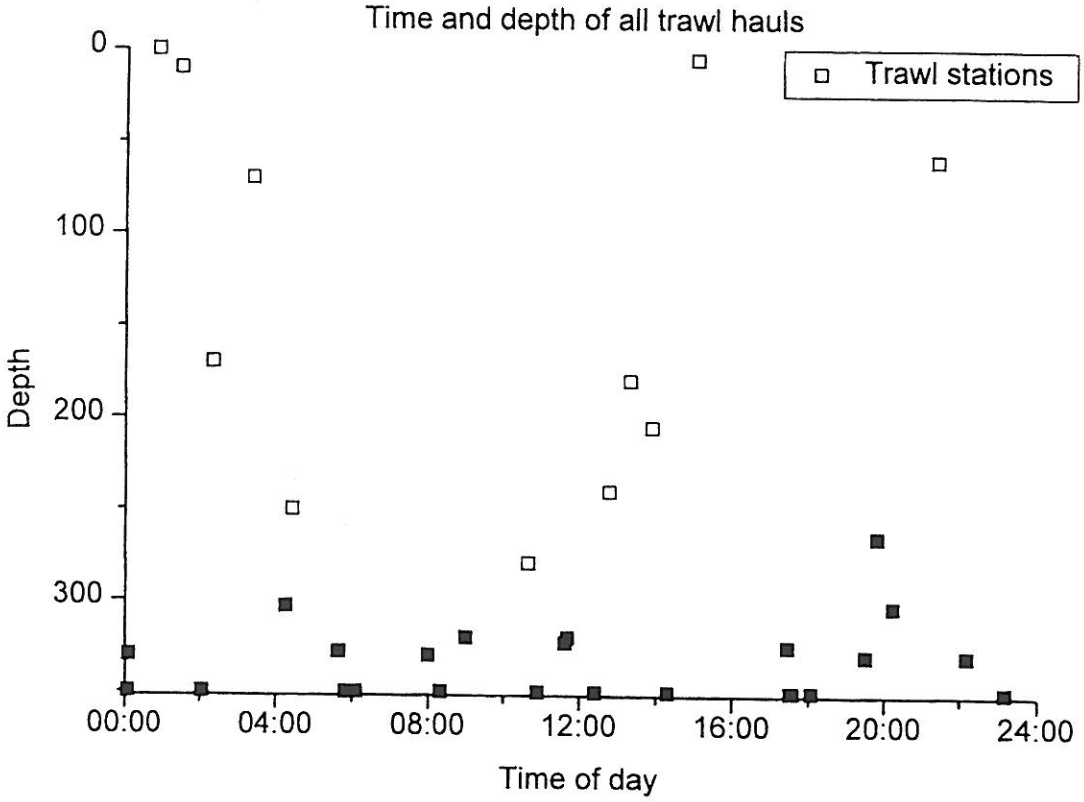

Figure 11. Time and depth of all trawl hauls. Filled squares are hauls with hake catches.

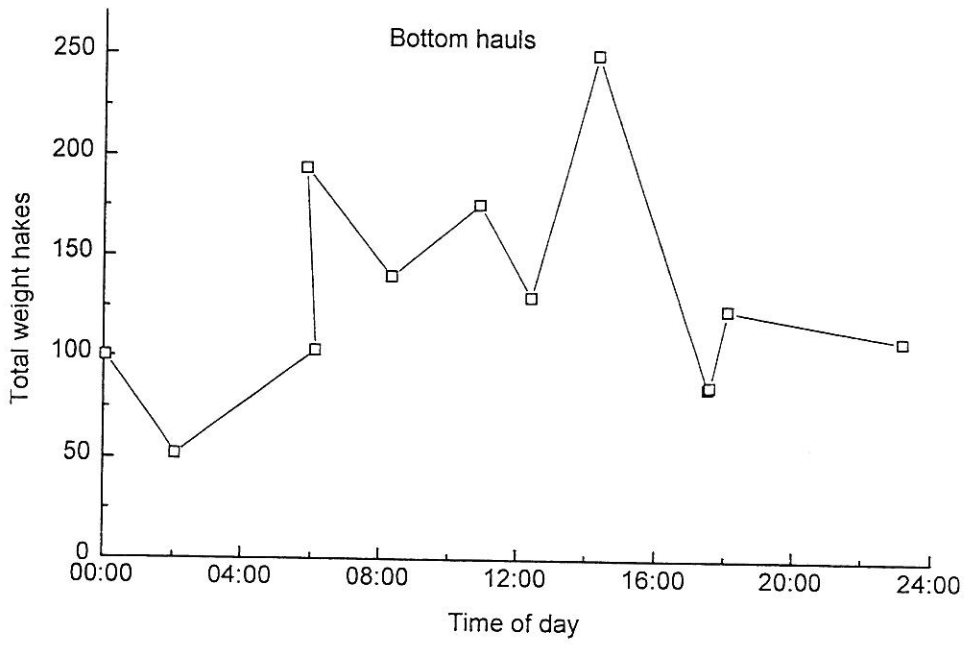

Figure 12. Total weights of both species of hake added together, bottom hauls.

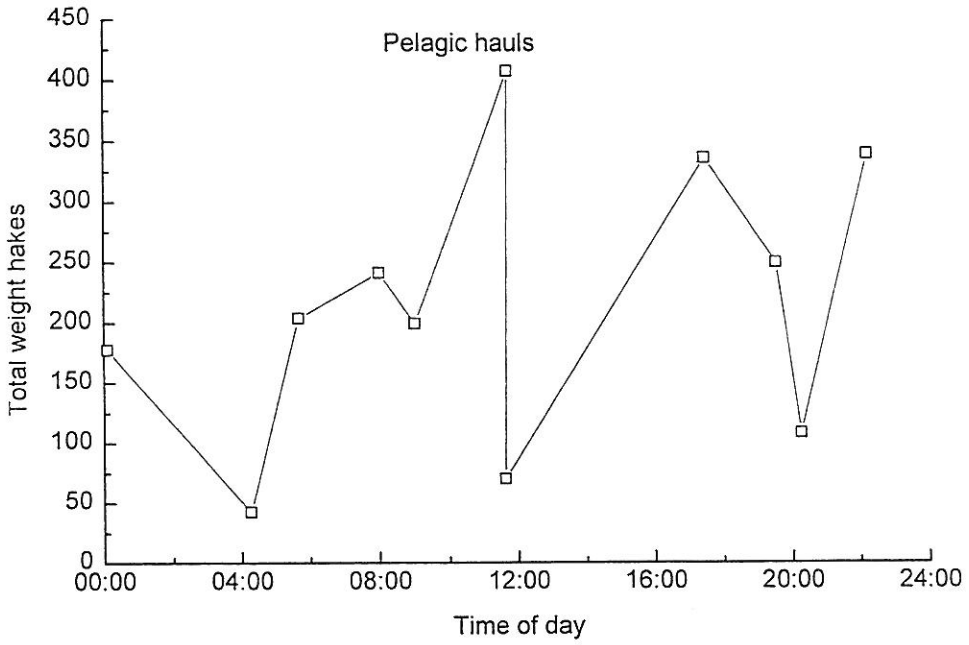

Figure 13. Total weights of both species of hake added together, pelagic hauls.

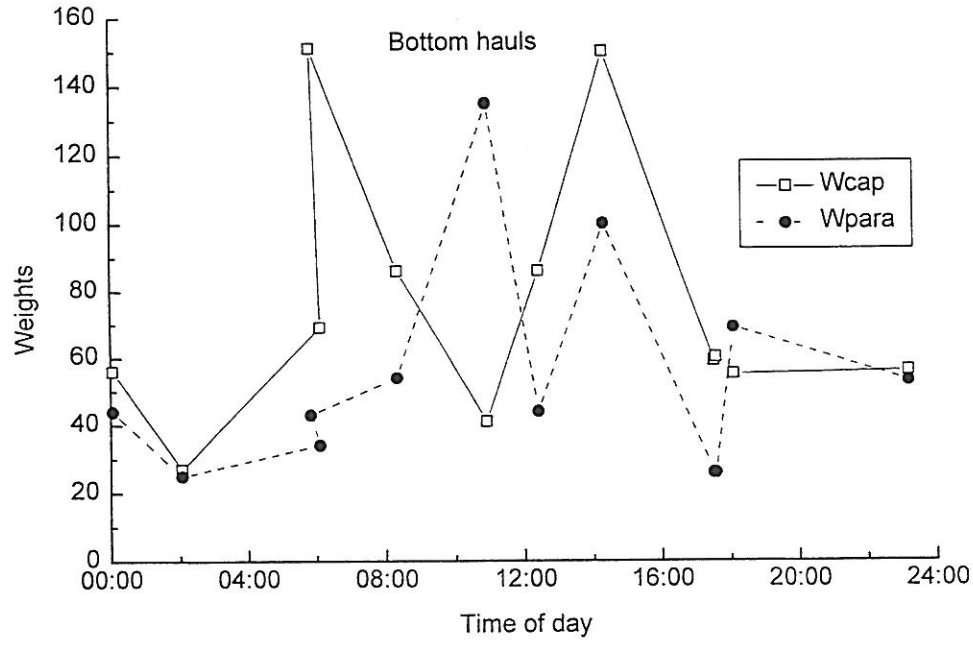

Figure 14. Weights of both hake species in all bottom hauls.

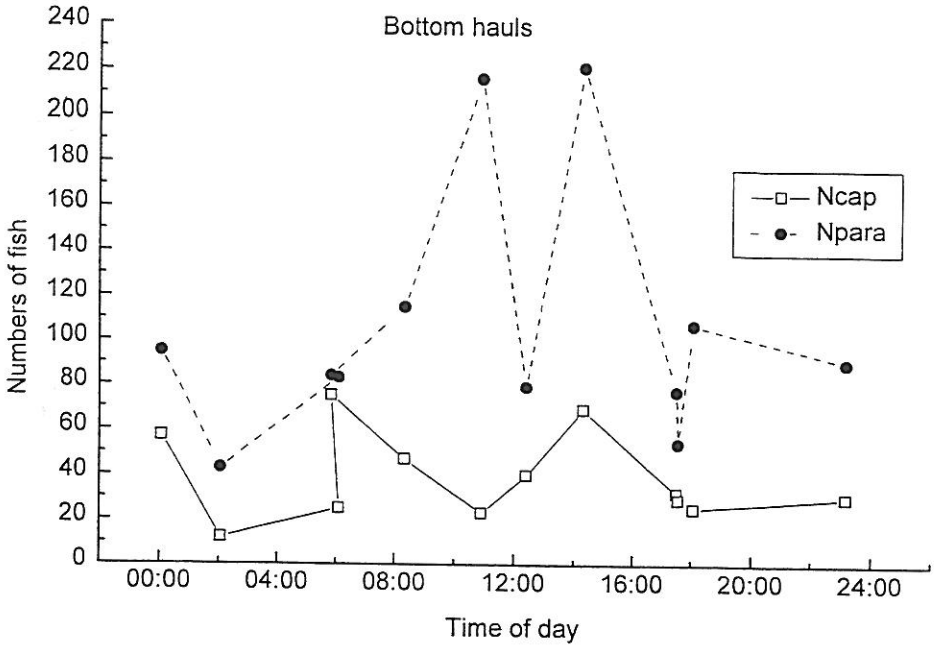

Figure 15. Numbers of both hake species in all bottom hauls.

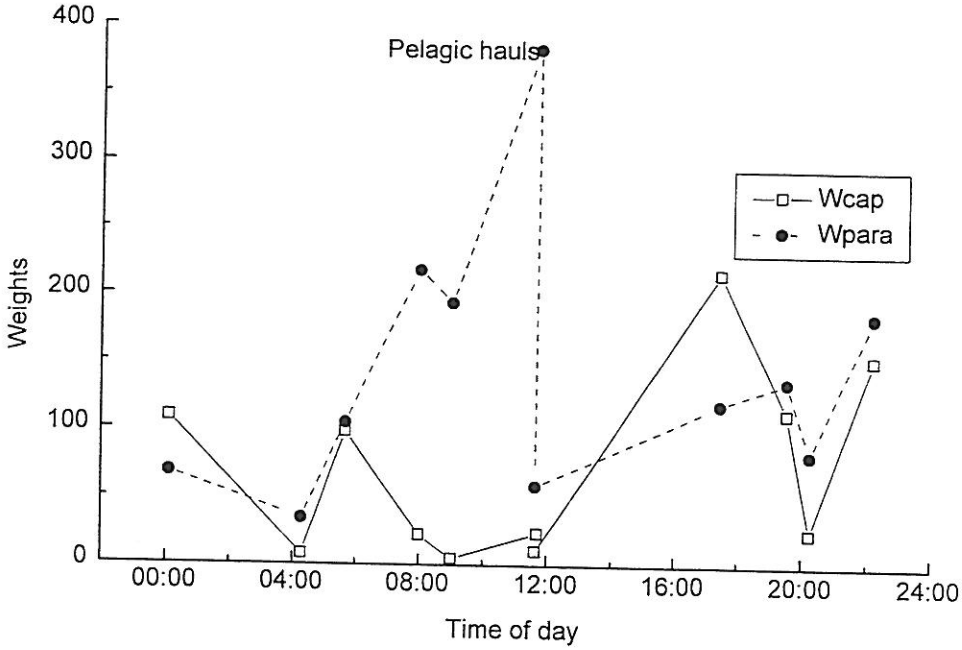

Figure 16. Weights of both hake species in all pelagic hauls.

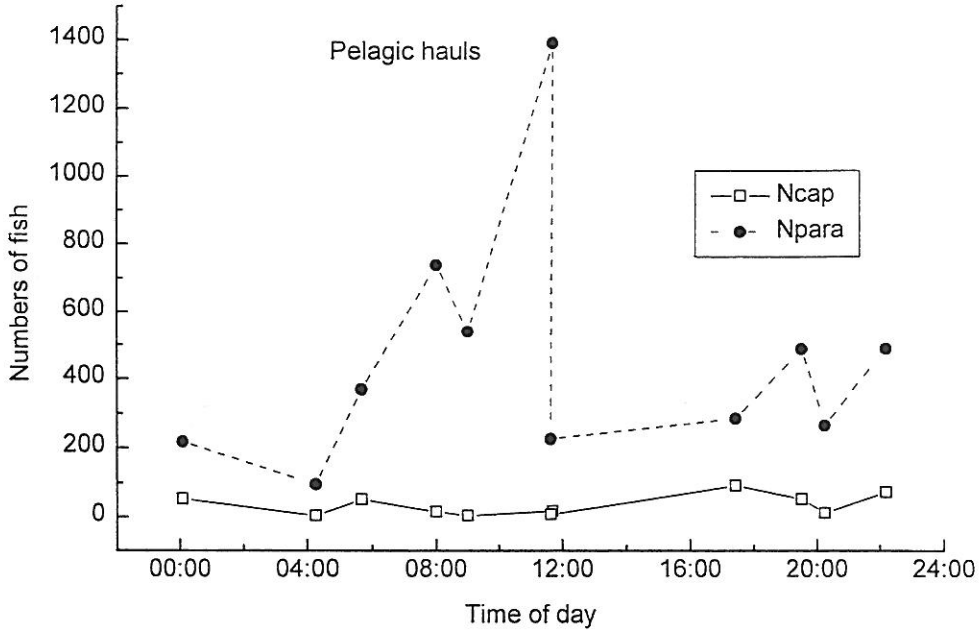

Figure 17. Numbers of both hake species in all pelagic hauls.

Stomach content

Stomach content from both hake species was investigated. The sampling was carried out in order to find if there was a feeding rhythm in hakes, and also to look at prey selection. The samples were collected from 8 bottom hauls and 6 deep pelagic hauls. The 14 *M. capensis* samples contained altogether 281 fish and the13 *M. paradoxus* samples contained 341 fish. Figures 18-22 show % of fishes with stomach content in all samples (Figure 18), bottom M. capensis samples (Figure 19), bottom *M. paradoxus* samples (Figure 20), pelagic *M. capensis* samples (Figure 21) and pelagic *M. paradoxus* samples (Figure 22) respectively. Neither of the data indicate a clear diurnal feeding periodicity, although there might be indications of high early evening values in both species. The data are, however, far from conclusive. This is in good accordance with the findings of Payne et al.(1987), Roel & Macpherson (1988), and Gordoa & Macpherson (1991), suggesting that at least older *M. capensis* do not exhibit marked feeding periodicity. This also seems to be the case for *M. paradoxus* in this investigation.

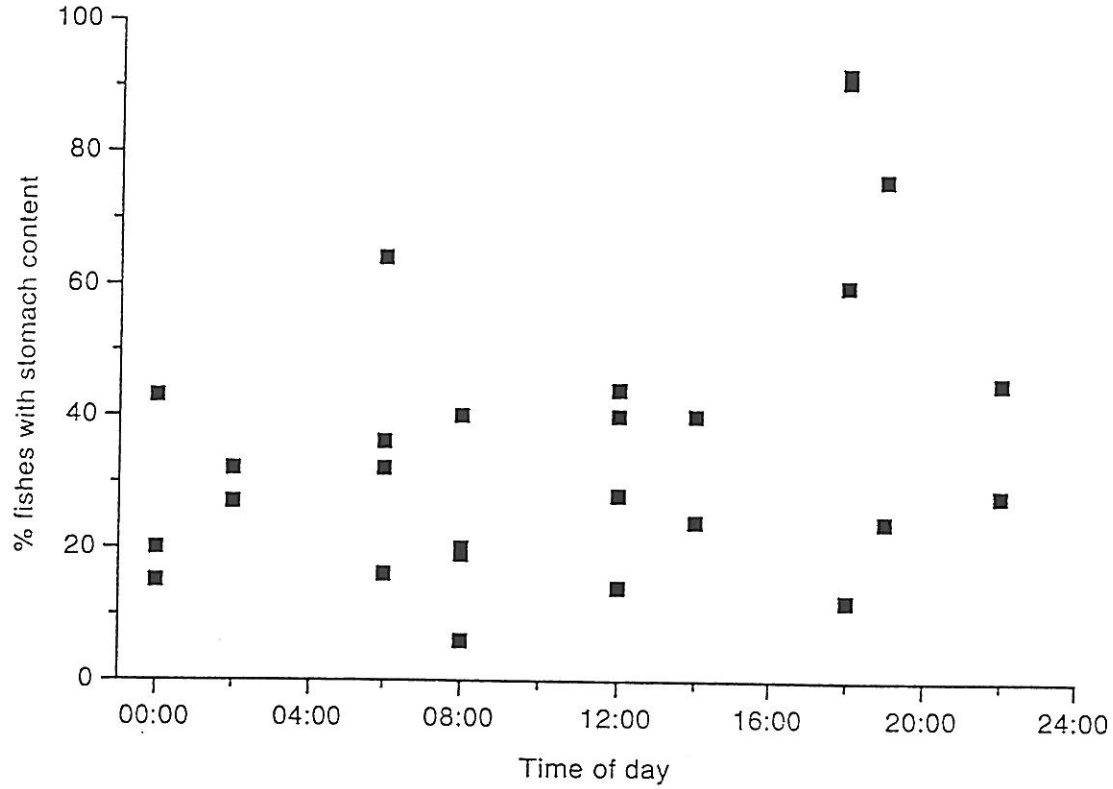

Figure 18. Percentage non-empty stomachs, all examined fish.

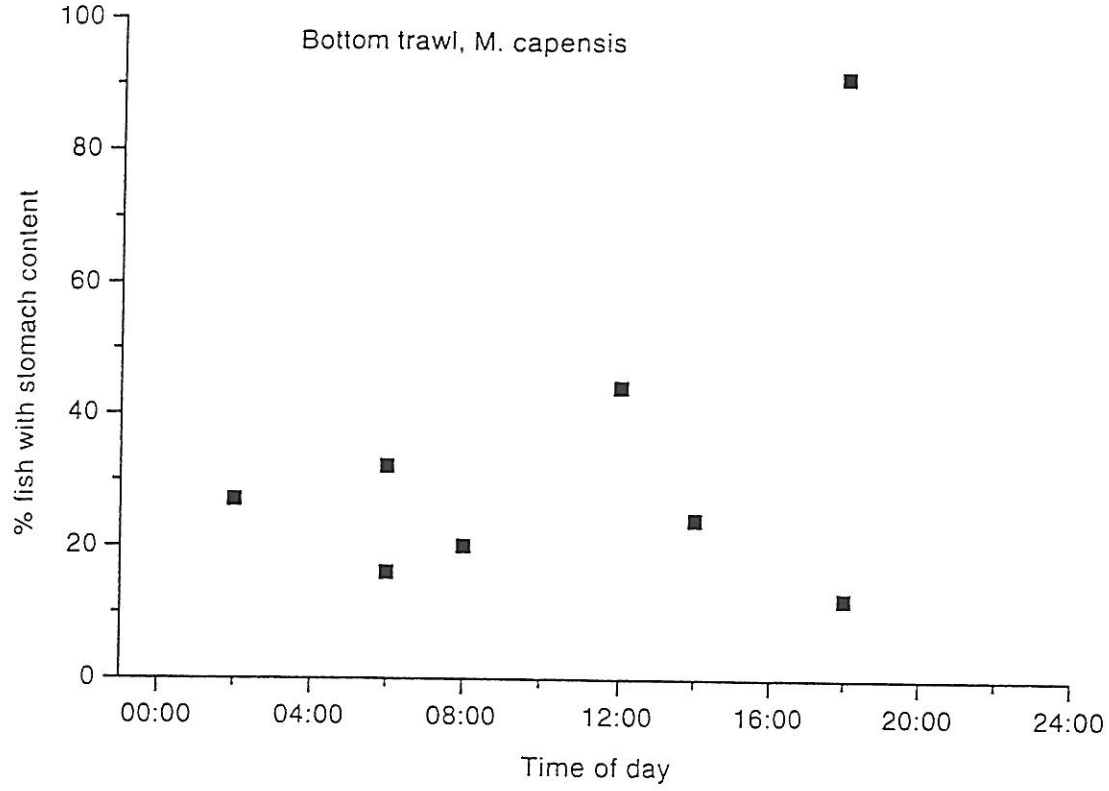

Figure 19. Percentage non-empty stomachs, bottom trawl, *M. capensis*.

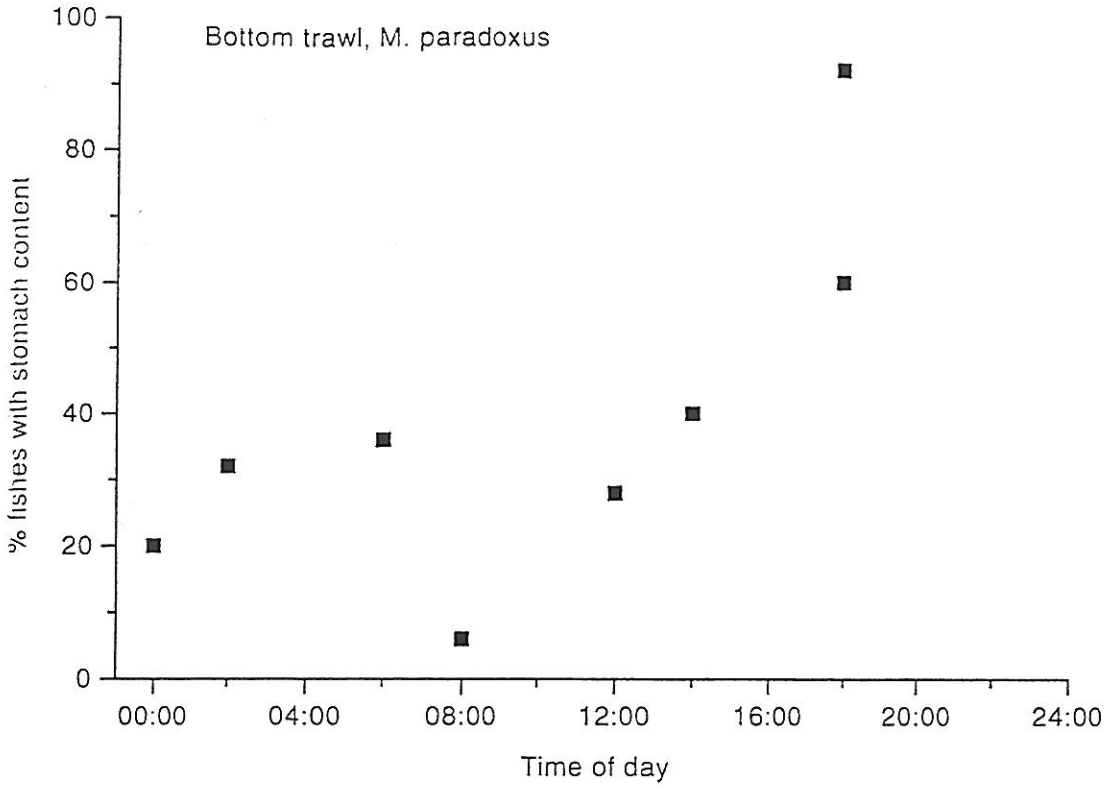

Figure 20. Percentage non-empty stomachs *M. paradoxus*.

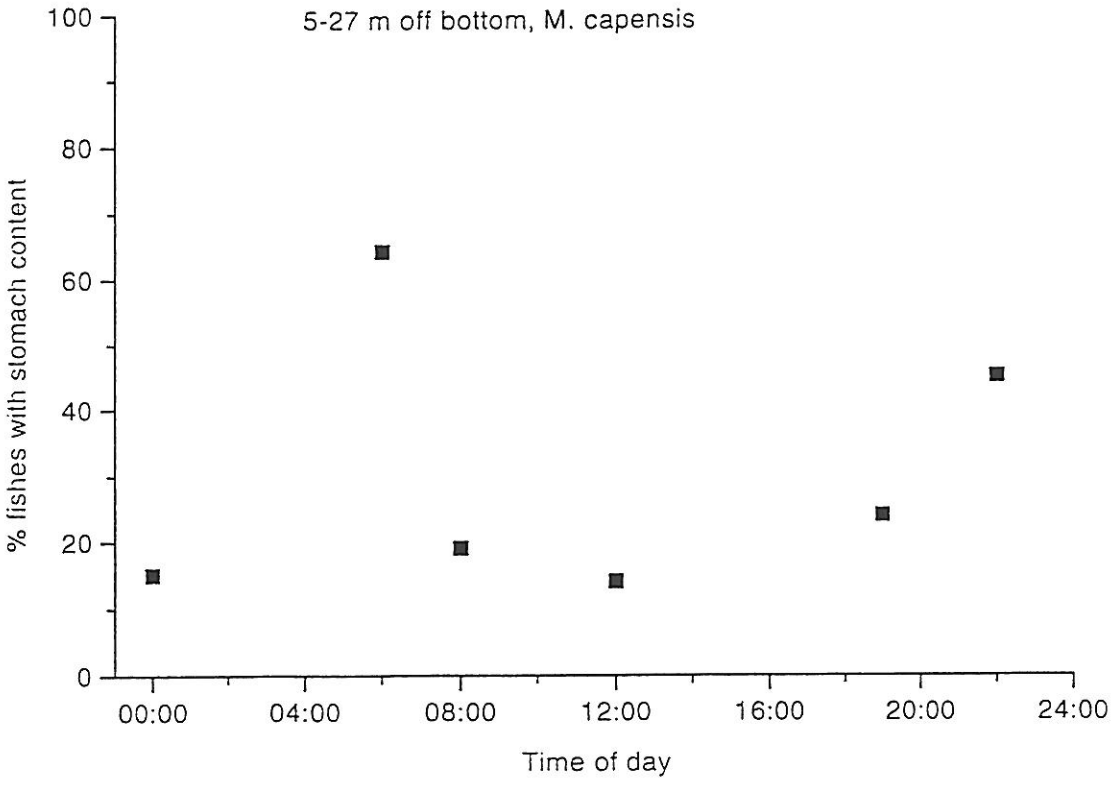

Figure 21. Percentage non-empty stomachs, off bottom *M. capensis*.

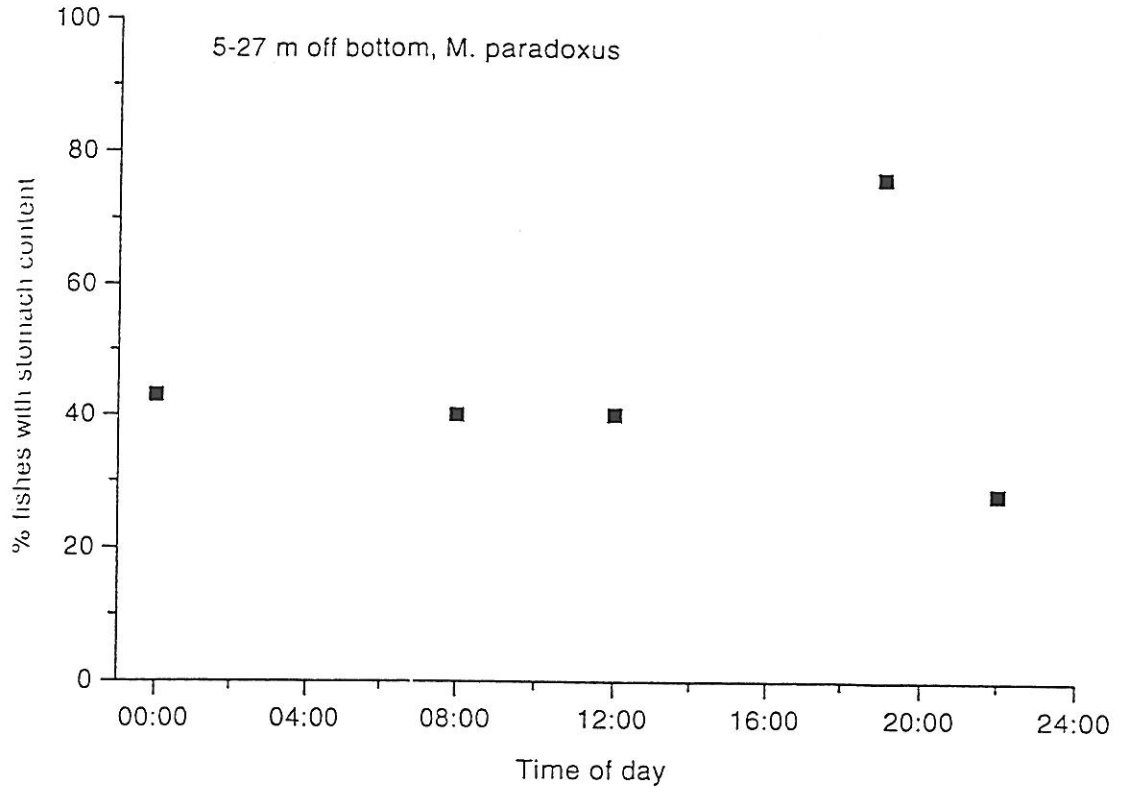

Figure 22. Percentage non-empty stomachs, off bottom, *M. paradoxus.*

For *M. capensis* the diet was varied, but contained mainly fish. Small hake and jacobever constituted the main biomass, but krill was also found very frequently. Quite large horse mackerel were also found, as were both small and large squid. *M. paradoxus* proved to be a krill eater. That agrees well with both size and semipelagic distribution. In addition Myctophids were frequently found, and also a few small squid.

3.4 Conclusions

The vertical dynamics of the different biological components of the ecosystem studied seemed to be quite stable and was characterised by segregation in distinct layers. The mesopelagic component exhibited an apparent diurnal variation in acoustic back-scattering properties similar to Norwegian herring and Icelandic bathypelagic redfish.

Hake were masked by mesopelagic fish during the day, but were available for acoustic recording at night. Hake generally did not migrate above 60 m from the bottom.

The availability of hake to the bottom trawl was somewhat higher during the day than at night, but there was little difference in pelagic hauls. Bottom or pelagic trawl hauls alone did not reflect the species or size composition of hakes in the area neither night nor day.

No clear diurnal feeding periodicity was demonstrated. Large *M. capensis* fed mainly on fish, while the smaller *M. paradoxus* were krill eaters.

In areas with mixed concentrations of both hake species, bottom hauls as well as pelagic hauls are necessary to find the correct species composition and size distribution. If mesopelagic fish are abundant, pelagic hauls are always necessary, as is night-time acoustic coverage.

3.5 On/off bottom trawling

The study on this cruise was purely methodological, and only 12 tows comprising 6 paired comparisons with the doors on and off bottom respectively were carried out. 125 kg chain weights on each wing end to maintain bottom contact were tried first, but had to be increased to 250 kg to obtain satisfactory results. Possibly even 300 kg or more would add to the robustness of the methodology, as constant bottom contact during the whole tow is an absolute prerequisite for this type of experiment. The results strongly supported this, as off-bottom tows with insufficient bottom contact gave very poor catches. This is probably because the fish are collecting and holding in front of the gear and slip under it as soon as it lifts. Constant attention to door height over the bottom, as well as towing speed is therefore also absolutely necessary to have good results. On the positive side, however, it was quite possible to maintain normal door- and wing spread trawling this way. This means that an experiment can be carried out where there is no sand cloud from door bottom contact to consider as a herding factor. Also, the noise caused by door contact with the bottom will be avoided. Finally, the hearding of the bridles will be negligible, as they will be angling upwards from the wing ends towards the doors, allowing the fish to pass under them. Consequently it may be assumed that the catch difference with the doors on and off bottom should be a representation of herding by doors, sand clouds and bridles. Still it must be remembered that there may be a herding effect by the bridles and doors, so that this catch difference is a minimum representation of the herding.

CHAPTER 4 OTHER EXPERIMENTS

4.1 Trawl observations

Two attempts at trawl observation with video camera in natural illumination were made, as well as one in deep water with artificial light. The objective was to try to observe gear bottom contact, and if possible, fish reactions around the trawl. In all instances the visibility in the water was not good enough to allow video observation. Even at 45-50 m there was too little light for the very sensitive camera used, and the visibility *per se* was also less than 2-2.5 m, and the camera looking down a hole in the net roof it was not possible to at all see the groundgear 4 m below.

In water deeper than 300 m the visibility was somewhat better, but there of course artificial light was necessary. And with considerable amounts of marine snow present the picture was like being in a veritable snow storm. Useful observations of gear details could, however, be made within a range of 1-2 m, but the application of such observations are quite limited.

The conclusion therefore is that if the "Nansen" Focus is to be used for video based gear observations it will have to be in waters outside of Namibia, either in the tropics or in South East Africa. Apart from that, gear geometry can be measured in Namibia with the FS3300 sonar on the Focus, something which can be useful particularly with the pelagic trawls.

4.2 Trawl calibration with "Welwitchia"

"Welwitchia" is presently being phased in to participate in the hake assessment surveys, and for that purpose a lighter version of the "Nansen" trawl is being considered. It was decided to do an intercalibration exercise between the two ships to evaluate whether the catch efficiencies of the two trawls were comparable.

The intercalibration studies were carried out with both vessels trawling side by side, 0.1-0.2 nautical miles apart day and night for about 24 hours. Seven comparative hauls were made. "Welwitchia" was using its standard Polyice 1000 kg doors, and it soon became evident that

they were not able to spread the gear, as a door spread of about 42 m was maximum as opposed to Nansen's >50m. The height was also too low, and the trawl dug deeply into the mud, catching more than a ton of substrate in every haul. Twenty additional floats were added to the headrope to lift the trawl. This increased the opening by one meter, but still it was more than one meter lower than that of the "Nansen" trawl. Other minor adjustments were also tried, like lengthening the headrope and lengthening the gear, but no substantial improvements were achieved. The conclusion therefore was to discontinue the intercalibration and suggest that "Welwitchia" try again with a larger set of doors which were already purchased but unfortunately were not brought for the intercalibration.

4.3 School density

A method for assessing pelagic fish schools by measuring school cross section areas with sonar has been developed within the Nansen programme. However, the fish densities in the schools, and consequently the numbers of fish in a stock is still not known with satisfactory precision. This problem area was therefore preliminarily addressed at this cruise.

School density of pelagic fish was to be addressed by count calibration of single targets on images obtained by the FS 3300 sonar on the Focus. By integration/school area measurement and counting the numbers of fish per unit of volume the number of fish in a school can be estimated, as can the acoustic target strength of the fish. The idea was to find schools of horse mackerel with the SA950 sonar and to subsequently run the Focus close to the schools in order to resolve single targets as deep into the schools as possible with the 2.6°x2.6° transducer of the FS 3300.

We did find suitable schools and launched the Focus to do sonar observations. But very soon it became clear that the fish were avoiding the Focus. Whether it be on the starboard or port side the fish kept a distance of about 40 m to the vehicle (Figure 23). As the FS3300 sonar would not be able to resolve single targets further away than about 30 m at the densities expected in such schools (>1 fish/m^3) the experiments were abandoned. Probably the avoidance was caused by sound waves emitted by the tow cable going through the sea. This could be heard and felt at the tow block. The phenomenon is known, and the remedy is to "feather" the cable with plastic strips. Probably this has to be done in order to reduce avoidance, particularly of pelagic fish which generally tend to be more easily influenced than groundfish.

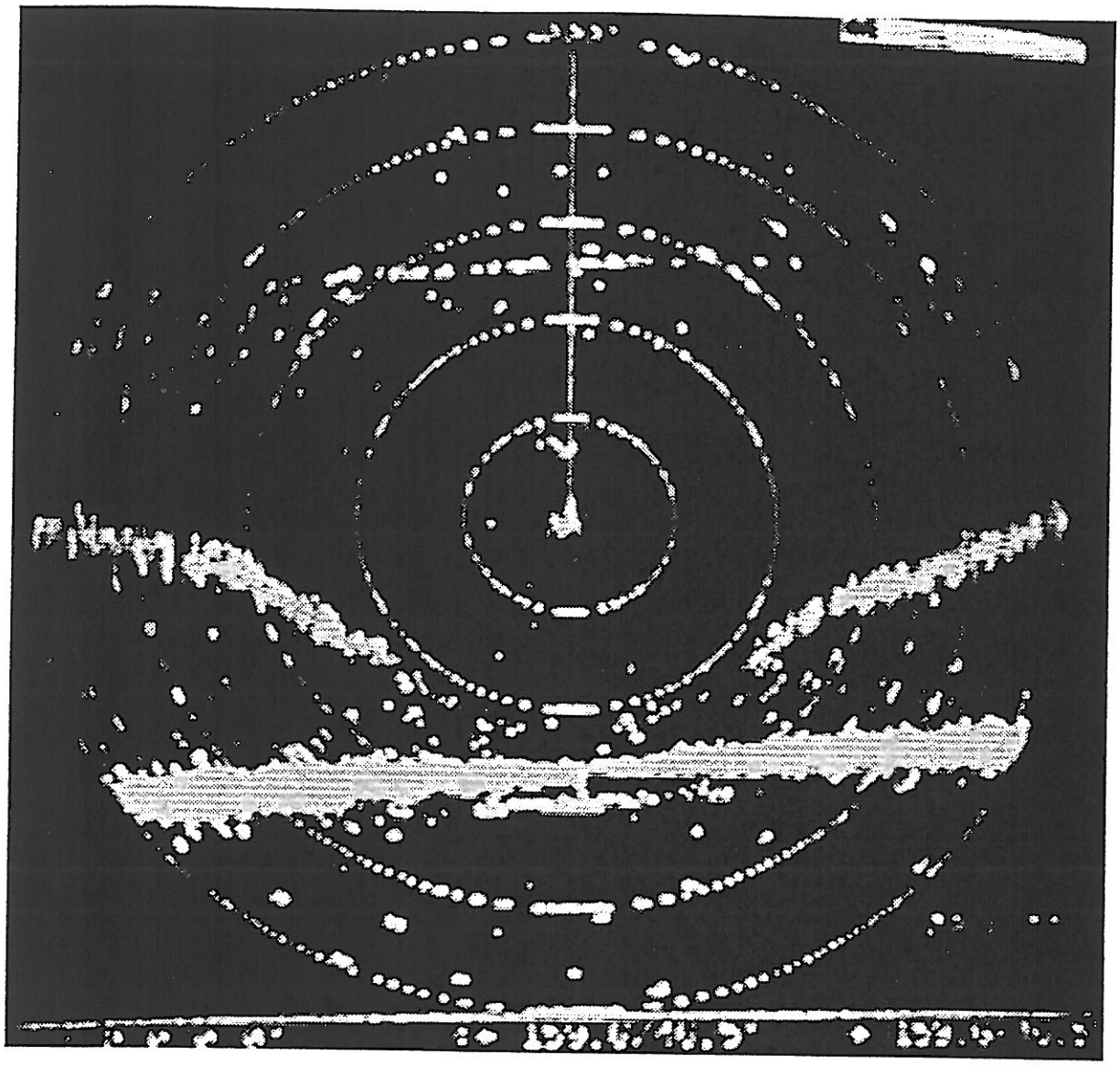

Figure 23. Scanning sonar picture of a vertical plane perpendicular to the ship's course. The bottom is horizontal. The bent band is a layer of horse mackerel avoiding the FOCUS 400 carrying the sonar, located in the centre of the picture.

4.4 Light measurements and bioluminescence

A surface light meter measured illumination during the whole cruise. The results for the observation period in Work Area II was presented above in Figure 7. It shows that all days were clear and sunny with peak readings of 17-1800 mE corresponding to around 90,000 lux. The underwater readings showed substantial extinction, reducing the illumination level to about 1 lux at 100m (Figure 24).

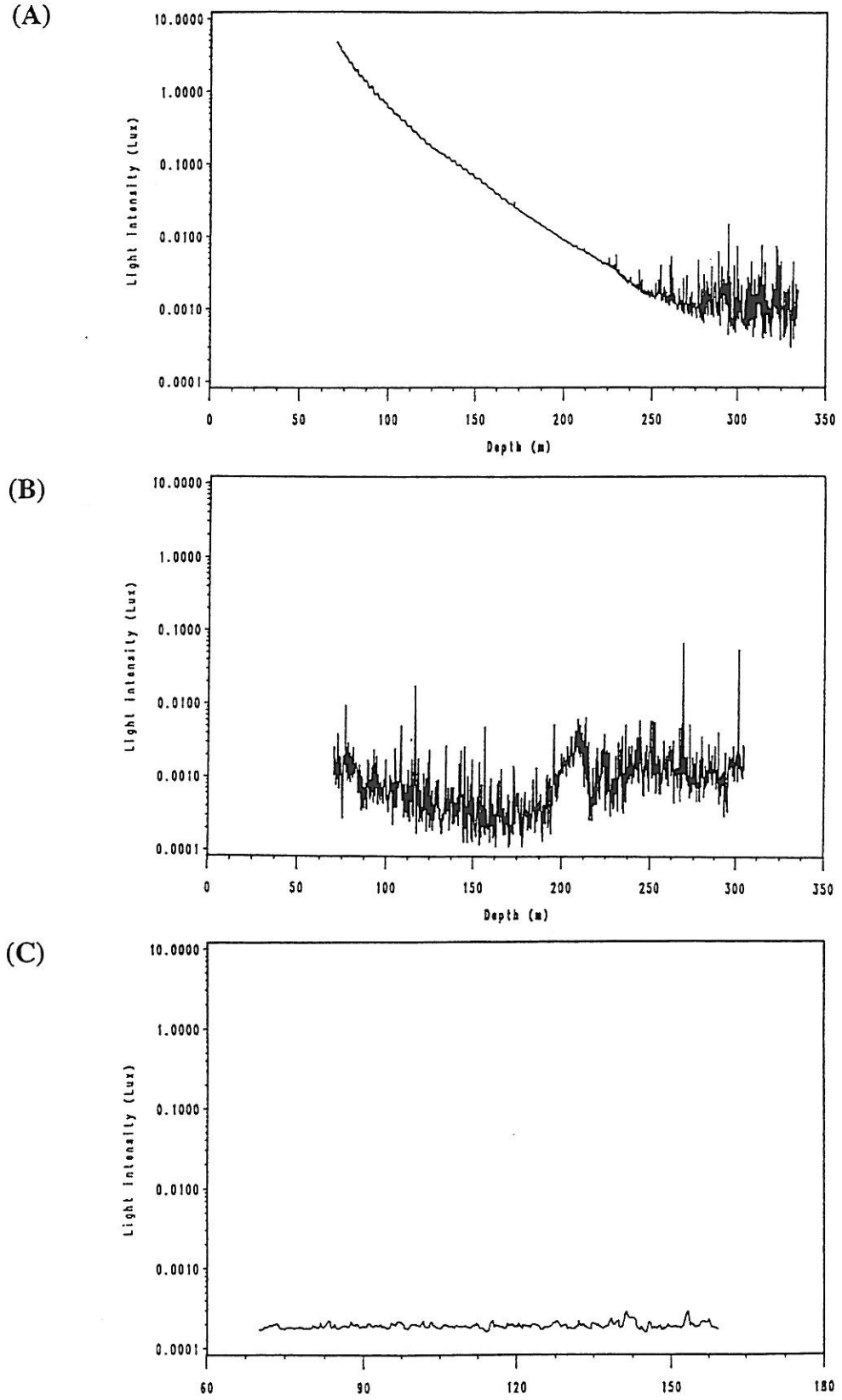

Figure 24. Light measurements. (A) Day-time underwater extinction curve with bioluminescence jitter below 230 m. (B) Night-time underwater curve showing bioluminescence jitter at all measured depths. (C) Surface recording to show that the jittering represents true readings.

Bioluminescence is a well known phenomenon and is believed to be used as antipredator and signalling mechanisms among mesopelagic fish and invertebrates. The very sensitive light meter used on the Focus (10^{-6} lux) was easily able to measure it as it ranged between 10^{-2} and 10^{-4} lux. It appeared to oscillate between these values, tending to jitter the light extinction curves substantially (Figure 24 a and b). That the jitter was caused by the bioluminescence and not by the light meter is shown by the dark curve in Figure 24 c. The bioluminescence range of illumination is well within the visual scope of many fishes, and it may be argued that illumination from bioluminescence could provide predators with opportunity of feeding. It is, however, uncertain whether such intermittent illumination can at all be utilised in this context, and it may also be that the Focus going through the layers of bioluminescent organisms may itself have induced at least part of the measured bioluminescence by triggering antipredator behaviour. Alternatively it is also quite likely that herding of fish by trawl gear may very well be a function of bioluminescence induced by the gear with doors and bridles going through the water. This may partly explain why herding is often seen to be similar day and night in many trawl fishing situations (Engås and Ona 1991, Huse *et al.* 1994).

CHAPTER 5 ECOPHYSIOLOGY OF CAPE HAKE

by Peter Woodhead

5.1 Introduction

The Cape hake is a dominant demersal predator on the Namibian shelf, where bottom waters are persistently depleted of oxygen. The hake are highly successful in these waters, although there are significant constraints for active predation in a hypoxic environment. Energy expenditures occur during swimming in pursuit and capture of prey. Anaerobic white muscles are used during burst swimming. Lactic acid produced accumulates and must subsequently be metabolised aerobicly. Further, digestion of prey is an oxidative process during which metabolic rates may double, or more. So, there are large aerobic costs incurred in the active pursuit, capture and digestion of prey. These oxygen debts must be replaced before further activities may take place. Availability of oxygen is critical to recovery. Therefore in hypoxic environments, recovery of oxygen debts from predation will be slow.

During a cruise in August 1995 measurements of gas taken from swimbladders of freshly caught Cape hake showed an average gas content of 89 % oxygen. It is possible that the swimbladder gas might provide an enriched source of oxygen which could be used to supplement respiratory requirements, through release of oxygen into the bloodstream when hake live in conditions of hypoxia. Such an adaptation might enable hake to recover more rapidly from energy expenditures and the oxygen debt acquired when pursuing and feeding on active prey. Such possibilities were investigated by making measurements of hake swimbladder gases during the present cruise.

5.2 Results

1. The average gas content in swimbladders was 89% oxygen for Cape hake which had empty stomachs.

2. Cape hake which were digesting food and had full stomachs (usually containing fish) had significantly lower oxygen content in swimbladder gas. There was a wide range of oxygen

contents measured for feeding hake; more than 40% of the measurements fell below the minimum oxygen contents for non-feeding hake swimbladders (Figure 25).

3. Measurements for possible diel changes in swimbladder oxygen content (associated with vertical migration) did not show significant differences between day and night for Cape hakes inhabiting the shelf-slope at 370m, where environmental dissolved oxygen concentrations were above 2ml O_2/litre.

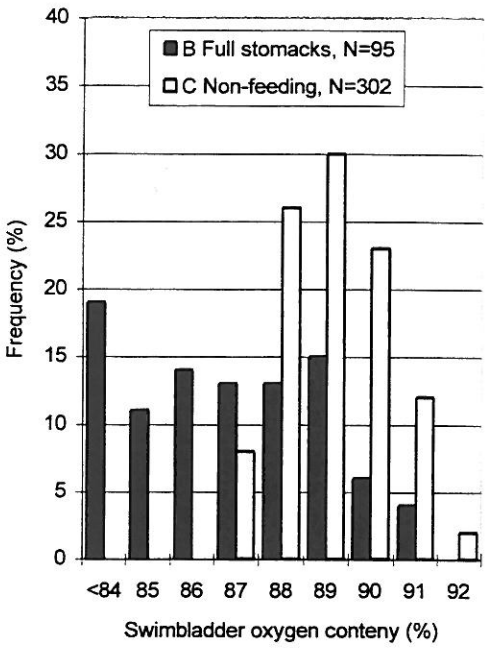

Figure 25 Oxygen contents (% O2) measured for swimbladder gas in Feeding and non-feeding Cape hake.

Collections of blood were made from freshly-caught hake. Both *Merluccius capensis* and *M. paradoxus* were sampled. Series of blood samples were taken from individual fish, and pooled samples were also collected. These materials will be used in investigations of the respiratory characteristics of hake. In particular, assessment of the oxygen-carrying capacity of the blood will be made, and the efficiency of hake haemoglobins to combine with oxygen in severely hypoxic environments will be measured through construction of haemoglobin-oxygen dissociation curves.

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Annex I Records of fishing stations

PROJECT STATION:1428

DATE:14/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2217

	start	stop	duration			
					Long	E 1414
TIME	:09:15:00	09:35:00	20	(min)	Purpose code:	1
LOG	: 445.00	446.30	1.30		Area code :	2
FDEPTH:	46	46			GearCond.code:	
BDEPTH:	46	46			Validity code:	

Towing dir: 335° Wire out: 200 m Speed: kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
N O C A T C H	0.00			
Total				

PROJECT STATION:1429

DATE:15/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2257

	start	stop	duration			
					Long	E 1306
TIME	:10:53:00	11:23:00	30	(min)	Purpose code:	1
LOG	: 561.20	562.80	1.60		Area code :	2
FDEPTH:	306	306			GearCond.code:	
BDEPTH:	306	306			Validity code:	

Towing dir: 345° Wire out:1050 m Speed: kn*10

Sorted: 30 Kg Total catch: 268.80 CATCH/HOUR: 537.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	225.00	3340	41.85	
Merluccius capensis	187.80	316	34.93	
Trachurus capensis	52.00	142	9.67	
Shrimps, small, non comm.	33.50		6.23	
Squalus megalops	16.40	50	3.05	
Chlorophthalmus atlanticus	5.90	590	1.10	
Genypterus capensis	4.80	2	0.89	
Coelorinchus fasciatus	3.90	120	0.73	
Galeus polli	3.10	30	0.58	
MYCTOPHIDAE	2.20		0.41	
Nezumia leonis	1.90	50	0.35	
Lepidopus caudatus	0.90	10	0.17	
Todaropsis eblanae	0.20	10	0.04	
Total	537.60		100.00	

PROJECT STATION:1430

DATE:19/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2138

	start	stop	duration			
					Long	E 1242
TIME	:08:08:00	08:41:00	33	(min)	Purpose code:	1
LOG	:1059.60	1061.20	1.60		Area code :	2
FDEPTH:	365	369			GearCond.code:	
BDEPTH:	365	369			Validity code:	

Towing dir: 165° Wire out:1150 m Speed: 32 kn*10

Sorted: 247 Kg Total catch: 544.54 CATCH/HOUR: 990.07

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	738.91	716	74.63	5007
Helicolenus dactylopterus	89.38	1358	9.03	
Centrolophus niger	59.64	65	6.02	
Hoplostethus cadenati	29.82	2240	3.01	
Chlorophthalmus atlanticus	27.85	1018	2.81	
Nezumia sp.	16.51	655	1.67	
Deepwater fish mixture	7.64		0.77	
Galeus polli	7.27	95	0.73	
Coelorinchus fasciatus	6.69	160	0.68	
Merluccius paradoxus	2.25	7	0.23	
Brama brama	2.15	4	0.22	
Lophius vomerinus	1.96	4	0.20	
Total	990.07		100.00	

PROJECT STATION:1431

DATE:14/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2138

	start	stop	duration			
					Long	E 1242
TIME	:14:17:00	14:45:00	28	(min)	Purpose code:	1
LOG	:1086.00	1087.00	1.00		Area code :	2
FDEPTH:	363	363			GearCond.code:	
BDEPTH:	363	363			Validity code:	9

Towing dir: 5° Wire out:1150 m Speed: 3 kn*10

Sorted: Kg Total catch: 1000.00 CATCH/HOUR: 2142.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MUD/SHELL	2142.86		100.00	
Total	2142.86		100.00	

PROJECT STATION:1432

DATE:19/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2139

	start	stop	duration			
					Long	E 1242
TIME	:16:16:00	16:46:00	30	(min)	Purpose code:	1
LOG	:1094.10	1095.60	1.50		Area code :	2
FDEPTH:	370	365			GearCond.code:	
BDEPTH:	370	365			Validity code:	

Towing dir: 360° Wire out:1000 m Speed: 30 kn*10

Sorted: 80 Kg Total catch: 204.81 CATCH/HOUR: 409.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	142.60	64	34.81	
Merluccius capensis	54.10	40	13.21	5008
Chlorophthalmus atlanticus	44.80	1792	10.94	
Merluccius paradoxus	44.12	116	10.77	5009
Shrimps, small, non comm.	32.30	15228	7.89	
Nezumia sp.	27.20	956	6.64	
Galeus polli	26.60	330	6.49	
Lophius vomerinus	13.50	10	3.30	
Todarodes sagittatus	9.40	20	2.29	
Coelorinchus fasciatus	5.40	220	1.32	
MYCTOPHIDAE	4.20	570	1.03	
Hoplostethus cadenati	3.90	220	0.95	
C R A B S	0.80	40	0.20	
Ebinania costaecanarie	0.60	10	0.15	
Notacanthus sexspinis	0.10	10	0.02	
Total	409.62		100.01	

PROJECT STATION:1433

DATE:19/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2140

	start	stop	duration			
					Long	E 1243
TIME	:21:08:00	21:38:00	30	(min)	Purpose code:	1
LOG	:1118.60	1120.30	1.70		Area code :	2
FDEPTH:	357	356			GearCond.code:	
BDEPTH:	357	356			Validity code:	

Towing dir: 360° Wire out:1100 m Speed: 34 kn*10

Sorted: 271 Kg Total catch: 357.09 CATCH/HOUR: 714.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	475.80	562	66.62	5010
Helicolenus dactylopterus	159.96	2678	22.40	
Deepwater fish mixture	24.00		3.36	
Chlorophthalmus atlanticus	22.20	924	3.11	
Lophius vomerinus	9.60	14	1.34	
Coelorinchus fasciatus	3.90	78	0.55	
Galeus polli	3.90	48	0.55	
Centrolophus niger	3.48	2	0.49	
Todarodes sagittatus	3.18	10	0.45	
RAJIDAE	2.78	2	0.39	
Squalus megalops	2.74	2	0.38	
Nezumia sp.	2.64	48	0.37	
Total	714.18		100.01	

PROJECT STATION:1434

DATE:20/ 4/96 GEAR TYPE: BT No:7 POSITION:Lat S 2141

	start	stop	duration			
					Long	E 1245
TIME	:02:32:00	03:02:00	30	(min)	Purpose code:	1
LOG	:1141.80	1141.30	0.50		Area code :	2
FDEPTH:	358	357			GearCond.code:	8
BDEPTH:	358	357			Validity code:	

Towing dir: 360° Wire out:1050 m Speed: 30 kn*10

Sorted: 12 Kg Total catch: 23.76 CATCH/HOUR: 47.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Galeus polli	11.20	132	23.57	
Coelorinchus fasciatus	9.28	216	19.53	
Helicolenus dactylopterus	6.56	124	13.80	
Lophius vomerinus	4.40	12	9.26	
Coelorinchus coelorhinc. polli	3.44	168	7.24	
Raja straeleni	3.20	4	6.73	
Shrimps, small, non comm.	2.48	1064	5.22	
Merluccius capensis	2.08	4	4.38	5012
Nezumia sp.	1.56	76	3.28	
Yarrella blackfordi	1.40	204	2.95	
Merluccius paradoxus	0.80	4	1.68	5011
Chlorophthalmus atlanticus	0.64	24	1.35	
Laemonema laureysi	0.24	4	0.51	
Selachophidium guentheri	0.12	4	0.25	
Ebinania costaecanarie	0.12	8	0.25	
Total	47.52		100.00	

PROJECT STATION:1435

DATE:20/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2140
start stop duration Long E 1243
TIME :10:16:00 10:46:00 30 (min) Purpose code: 1
LOG :1166.10 1167.90 1.80 Area code : 2
FDEPTH: 360 359 GearCond.code:
BDEPTH: 360 359 Validity code:
Towing dir: 360° Wire out:1100 m Speed: 36 kn*10

Sorted: 85 Kg Total catch: 207.64 CATCH/HOUR: 415.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	171.90	3378	41.39	
Merluccius capensis	55.00	44	13.24	5013
Merluccius paradoxus	44.20	168	10.64	5014
Centrolophus niger	43.56	26	10.49	
Chlorophthalmus atlanticus	37.98	1556	9.15	
Galeus polli	24.56	278	5.91	
Deepwater fish mixture	10.16		2.45	
Nezumia sp.	9.98	332	2.40	
Hoplostethus cadenati	8.64	594	2.08	
Yarrella blackfordi	3.78	404	0.91	
Shrimps, small, non comm.	2.78	1310	0.67	
Coelorinchus fasciatus	0.80	26	0.19	
Notacanthus sexspinis	0.80	36	0.19	
Todarodes sagittatus	0.54	8	0.13	
Lophius vomerinus	0.26	8	0.06	
Todaropsis eblanae	0.18	18	0.04	
C R A B S	0.08	8	0.02	
Epigonus denticulatus	0.08	8	0.02	
Total	415.28		99.98	

PROJECT STATION:1436

DATE:20/ 4/96 GEAR TYPE: PT No: POSITION:Lat S 2142
start stop duration Long E 1244
TIME :15:26:00 15:56:00 30 (min) Purpose code: 1
LOG :1185.00 1186.00 1.00 Area code : 2
FDEPTH: 354 352 GearCond.code:
BDEPTH: 354 352 Validity code:
Towing dir: 3° Wire out:1050 m Speed: 30 kn*10

Sorted: 107 Kg Total catch: 230.20 CATCH/HOUR: 460.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	178.00	2902	38.66	
Merluccius capensis	143.80	134	31.23	5015
Centrolophus niger	32.00	10	6.95	
Chlorophthalmus atlanticus	21.30	1000	4.63	
Galeus polli	15.50	180	3.37	
Todarodes sagittatus	13.10	46	2.85	
Nezumia sp.	11.30	420	2.45	
Merluccius paradoxus	10.00	34	2.17	5016
Lophius vomerinus	8.60	20	1.87	
Deania profundorum	5.40	10	1.17	
Yarrella blackfordi	4.70	610	1.02	
Coelorinchus fasciatus	4.60	130	1.00	
Hoplostethus cadenati	4.10	280	0.89	
Coelorinchus coelorhinc. polli	2.70	80	0.59	
Malacocephalus laevis	2.40	30	0.52	
Notacanthus sexspinis	1.90	80	0.41	
Shrimps, small, non comm.	0.80	230	0.17	
Ebinania costaecanarie	0.20	20	0.04	
Total	460.40		99.99	

PROJECT STATION:1437

DATE:20/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2140
start stop duration Long E 1243
TIME :20:54:00 21:24:00 30 (min) Purpose code: 1
LOG :1205.10 1206.70 1.60 Area code : 2
FDEPTH: 353 355 GearCond.code:
BDEPTH: 353 355 Validity code:
Towing dir: 360° Wire out:1100 m Speed: 32 kn*10

Sorted: 135 Kg Total catch: 193.02 CATCH/HOUR: 386.04

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	213.20	336	55.23	5017
Helicolenus dactylopterus	123.60	2480	32.02	
Chlorophthalmus atlanticus	31.86	1230	8.25	
Lophius vomerinus	3.54	6	0.92	
Todarodes sagittatus	3.36	6	0.87	
Nezumia sp.	2.70	78	0.70	
Yarrella blackfordi	2.10	216	0.54	
Galeus polli	1.86	24	0.48	
Genypterus capensis	0.80	2	0.21	
Coelorinchus fasciatus	0.78	12	0.20	
Merluccius paradoxus	0.74	2	0.19	5018
Shrimps, small, non comm.	0.72	348	0.19	
Hoplostethus cadenati	0.72	42	0.19	
Malacocephalus laevis	0.06	6	0.02	
Total	386.04		100.01	

PROJECT STATION:1438

DATE:21/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2420
start stop duration Long E 1339
TIME :17:31:00 18:01:00 30 (min) Purpose code: 1
LOG :1415.50 1417.00 1.50 Area code : 2
FDEPTH: 331 336 GearCond.code:
BDEPTH: 331 336 Validity code:
Towing dir: 170° Wire out:1000 m Speed: 30 kn*10

Sorted: 137 Kg Total catch: 248.27 CATCH/HOUR: 496.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	117.60	64	23.68	5019
Helicolenus dactylopterus	115.00	2024	23.16	
Nezumia sp.	79.80	1910	16.07	
Coelorinchus fasciatus	75.90	3276	15.29	
Merluccius paradoxus	51.60	154	10.39	5020
Genypterus capensis	30.90	28	6.22	5021
Lophius vomerinus	13.70	20	2.76	
Centrolophus niger	5.74	2	1.16	
Galeus polli	2.70	110	0.54	
Squilla acuelata calmani	2.50	130	0.50	
MYCTOPHIDAE	1.10	170	0.22	
Total	496.54		99.99	

PROJECT STATION:1439

DATE:21/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2422
start stop duration Long E 1339
TIME :20:15:00 21:00:00 45 (min) Purpose code: 1
LOG :1424.00 1426.50 2.50 Area code : 2
FDEPTH: 303 290 GearCond.code:
BDEPTH: 337 346 Validity code:
Towing dir: 186° Wire out: 840 m Speed: 30 kn*10

Sorted: 199 Kg Total catch: 279.91 CATCH/HOUR: 373.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	185.53	593	49.71	5022
Merluccius capensis	55.93	27	14.99	5023
Photichthys argenteus	55.08	6295	14.76	
MYCTOPHIDAE	23.67	657	6.34	
Epigonus denticulatus	14.64	896	3.92	
MYCTOPHIDAE	10.65	269	2.85	
Helicolenus dactylopterus	7.76	152	2.08	
Coelorinchus fasciatus	6.28	96	1.68	
Centrolophus niger	3.21	1	0.86	
Krill	2.80		0.75	
Nezumia sp.	2.64	44	0.71	
Genypterus capensis	2.24	3	0.60	5024
Sepia sp.	1.40	60	0.38	
Galeus polli	0.44	4	0.12	
Scopelosaurus meadi	0.35	12	0.09	
Thyrsites atun	0.28	1	0.08	
Todarodes sagittatus	0.20	4	0.05	
Ebinania costaecanarie	0.11	11	0.03	
Total	373.21		100.00	

PROJECT STATION:1440

DATE:22/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2425
start stop duration Long E 1338
TIME :01:10:00 01:40:00 30 (min) Purpose code:
LOG :1436.20 1438.10 1.90 Area code : 2
FDEPTH: 349 355 GearCond.code: 7
BDEPTH: 349 355 Validity code: 9
Towing dir: 185° Wire out:1050 m Speed: 30 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Total				

PROJECT STATION:1441

DATE:22/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2425
start stop duration Long E 1338
TIME :04:16:00 05:01:00 45 (min) Purpose code: 1
LOG :1446.30 1448.60 2.30 Area code : 2
FDEPTH: 303 305 GearCond.code:
BDEPTH: 348 357 Validity code:
Towing dir: 180° Wire out: 776 m Speed: 30 kn*10

Sorted: 88 Kg Total catch: 248.70 CATCH/HOUR: 331.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Photichthys argenteus	144.64	14083	43.62	
Merluccius paradoxus	70.20	196	21.17	5026
MYCTOPHIDAE	59.04	8433	17.80	
Merluccius capensis	15.67	7	4.73	5025
Krill	11.04		3.33	
Epigonus denticulatus	10.24	416	3.09	
Sepia sp.	7.52	1328	2.27	
Brama brama	5.37	3	1.62	
TETRAGONURIDAE	3.61	12	1.09	
Genypterus capensis	2.68	1	0.81	
NEMICHTHYIDAE	0.80	16	0.24	
Todarodes sagittatus	0.79	1	0.24	
N O C A T C H	0.00			
Total	331.60		100.01	

PROJECT STATION:1442

DATE:22/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2425
start stop duration Long E 1338
TIME :09:01:00 09:31:00 30 (min) Purpose code: 1
LOG :1460.20 1461.70 1.50 Area code : 2
FDEPTH: 320 330 GearCond.code: 1
BDEPTH: 348 354 Validity code:
Towing dir: 180° Wire out: 860 m Speed: 30 kn*10

Sorted: 135 Kg Total catch: 335.10 CATCH/HOUR: 670.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	387.46	1080	57.81	5027
MYCTOPHIDAE	136.40	17946	20.35	
Todarodes sagittatus	72.70	282	10.85	
BRAMIDAE	32.30	6	4.82	
Centrolophus niger	17.30	16	2.58	
Merluccius capensis	9.54	8	1.42	5028
Todaropsis eblanae	6.00	1240	0.90	
Photichthys argenteus	4.40	440	0.66	
BRAMIDAE	1.84	4	0.27	
Lepidopus caudatus	1.74	2	0.26	
Beryx splendens	0.48	4	0.07	
Total	670.16		99.99	

PROJECT STATION:1443

DATE:22/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :10:54:00 11:28:00 34 (min) Purpose code: 1
LOG :1467.40 1468.90 1.50 Area code : 2
FDEPTH: 352 358 GearCond.code:
BDEPTH: 352 358 Validity code:
Towing dir: 170° Wire out:1080 m Speed: 30 kn*10

Sorted: 236 Kg Total catch: 437.42 CATCH/HOUR: 771.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	237.44	381	30.76	5029
Krill	154.41		20.00	
Helicolenus dactylopterus	117.97	1406	15.28	
Galeus polli	80.79	1828	10.47	
Merluccius capensis	72.18	41	9.35	5030
Centrolophus niger	31.50	14	4.08	
Coelorinchus fasciatus	26.44	334	3.43	
Nezumia sp.	25.45	531	3.30	
Genypterus capensis	12.71	12	1.65	5031
Epigonus denticulatus	4.82	185	0.62	
MYCTOPHIDAE	1.61	185	0.21	
Photichthys argenteus	1.61	185	0.21	
Neoharriotta pinnata	1.55	2	0.20	
Todarodes sagittatus	1.36	2	0.18	
Notacanthus sexspinis	0.86	37	0.11	
Selachophidium guentheri	0.74	49	0.10	
Laemonema laureysi	0.49	12	0.06	
Total	771.93		100.01	

PROJECT STATION:1444

DATE:22/ 4/96 GEAR TYPE: PT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :12:48:00 13:21:00 33 (min) Purpose code: 1
LOG :1474.00 1475.80 1.80 Area code : 2
FDEPTH: 240 240 GearCond.code:
BDEPTH: 353 361 Validity code:
Towing dir: 173° Wire out: 620 m Speed: 35 kn*10

Sorted: 15 Kg Total catch: 110.81 CATCH/HOUR: 201.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	105.35	12642	52.29	
Sepia sp.	81.75	13624	40.58	
Brama brama	10.56	5	5.24	
Photichthys argenteus	3.82	522	1.90	
Total	201.48		100.01	

PROJECT STATION:1445

DATE:22/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :18:05:00 18:35:00 30 (min) Purpose code: 1
LOG :1492.70 1494.30 1.60 Area code : 2
FDEPTH: 354 360 GearCond.code:
BDEPTH: 354 360 Validity code:
Towing dir: 180° Wire out:1080 m Speed: 32 kn*10

Sorted: 159 Kg Total catch: 218.86 CATCH/HOUR: 437.72

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	148.10	228	33.83	5034
Merluccius capensis	118.50	54	27.07	5032
Helicolenus dactylopterus	106.20	1176	24.26	
Coelorinchus fasciatus	17.82	174	4.07	
Genypterus capensis	15.90	14	3.63	5033
Nezumia sp.	15.72	342	3.59	
Galeus polli	9.24	270	2.11	
MYCTOPHIDAE	2.70	288	0.62	
Photichthys argenteus	1.14	102	0.26	
Selachophidium guentheri	0.78	54	0.18	
Epigonus denticulatus	0.72		0.16	
S H R I M P S	0.54	144	0.12	
Notacanthus sexspinis	0.24	6	0.05	
Ebinania costaecanarie	0.12	12	0.03	
Total	437.72		99.98	

PROJECT STATION:1446

DATE:22/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2426
start stop duration Long E 1339
TIME :19:50:00 20:20:00 30 (min) Purpose code: 1
LOG :1500.50 1502.20 1.70 Area code : 2
FDEPTH: 265 290 GearCond.code: 1
BDEPTH: 353 360 Validity code:
Towing dir: 180° Wire out: 780 m Speed: 34 kn*10

Sorted: 17 Kg Total catch: 40.42 CATCH/HOUR: 80.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Photichthys argenteus	43.20	4036	53.44	
MYCTOPHIDAE	16.50	2302	20.41	
Krill	4.60		5.69	
Sepia sp.	4.40	666	5.44	
Centrolophus niger	4.00	4	4.95	
Todarodes sagittatus	3.20	4	3.96	
Merluccius paradoxus	2.80	8	3.46	5035
Lampanyctodes hectoris	1.84	836	2.28	
Epigonus denticulatus	0.30	30	0.37	
Total	80.84		100.00	

PROJECT STATION:1447

DATE:22/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2425
start stop duration Long E 1338
TIME :21:24:00 22:10:00 46 (min) Purpose code: 1
LOG :1507.80 1510.50 2.70 Area code : 2
FDEPTH: 60 77 GearCond.code: 1
BDEPTH: 350 360 Validity code:
Towing dir: 180° Wire out: 240 m Speed: 30 kn*10

Sorted: 9 Kg Total catch: 108.67 CATCH/HOUR: 141.74

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	118.70	13848	83.74	
Lampanyctodes hectoris	15.65	7826	11.04	
Krill	4.81		3.39	
Photichthys argenteus	1.03	86	0.73	
Sepia sp.	1.03	172	0.73	
Todarodes sagittatus	0.52	7	0.37	
Total	141.74		100.00	

PROJECT STATION:1448

DATE:23/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2427
start stop duration Long E 1339
TIME :23:11:00 23:41:00 30 (min) Purpose code: 1
LOG :1516.10 1517.70 1.60 Area code : 2
FDEPTH: 355 360 GearCond.code:
BDEPTH: 355 360 Validity code:
Towing dir: 180° Wire out:1080 m Speed: 30 kn*10

Sorted: 27 Kg Total catch: 224.59 CATCH/HOUR: 449.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	163.20	2000	36.33	
Merluccius capensis	120.40	64	26.80	5036
Merluccius paradoxus	113.70	192	25.31	5037
C R U S T A C E A N S	11.92		2.65	
Nezumia sp.	11.12	248	2.48	
Galeus polli	9.84	240	2.19	
Coelorinchus fasciatus	5.68	158	1.26	
Genypterus capensis	4.76	6	1.06	
MYCTOPHIDAE	2.88	400	0.64	
Epigonus denticulatus	1.84	72	0.41	
Selachophidium guentheri	1.84	48	0.41	
Lampanyctodes hectoris	0.72	528	0.16	
Photichthys argenteus	0.56	56	0.12	
Notacanthus sexspinis	0.56	8	0.12	
Ebinania costaecanarie	0.16	8	0.04	
Total	449.18		99.98	

PROJECT STATION:1449

DATE:23/ 4/96 GEAR TYPE: PT No:2 POSITION:Lat S 2428
start stop duration Long E 1339
TIME :00:52:00 01:23:00 31 (min) Purpose code: 1
LOG :1521.30 1523.00 1.70 Area code : 2
FDEPTH: 0 2 GearCond.code:
BDEPTH: 359 352 Validity code:
Towing dir: 360° Wire out: 170 m Speed: 35 kn*10

Sorted: 1 Kg Total catch: 180.55 CATCH/HOUR: 349.45

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	340.01	147650	97.30	
Sepia sp.	9.45	2834	2.70	
Total	349.46		100.00	

PROJECT STATION:1450

DATE:23/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1339
TIME :02:20:00 02:50:00 30 (min) Purpose code: 1
LOG :1525.00 1527.00 2.00 Area code : 2
FDEPTH: 170 170 GearCond.code:
BDEPTH: 357 357 Validity code:
Towing dir: 180° Wire out: 450 m Speed: 35 kn*10

Sorted: 34 Kg Total catch: 104.77 CATCH/HOUR: 209.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	169.08	40158	80.69	
Krill	37.02		17.67	
Centrolophus niger	3.16	2	1.51	
Todarodes sagittatus	0.28	2	0.13	
Total	209.54		100.00	

PROJECT STATION:1451

DATE:23/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2425
start stop duration Long E 1338
TIME :05:50:00 06:20:00 30 (min) Purpose code: 1
LOG :1534.90 1536.40 1.50 Area code : 2
FDEPTH: 351 356 GearCond.code:
BDEPTH: 351 356 Validity code:
Towing dir: 180° Wire out:1080 m Speed: 30 kn*10

Sorted: Kg Total catch: 239.76 CATCH/HOUR: 479.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	302.10	150	63.00	5038
Merluccius paradoxus	86.10	168	17.96	5039
Helicolenus dactylopterus	32.40	370	6.76	
Krill	18.74		3.91	
Schedophilus huttoni	12.70	6	2.65	
Genypterus capensis	9.00	10	1.88	5040
Nezumia sp.	6.94	150	1.45	
Coelorinchus fasciatus	5.28	80	1.10	
Lophius vomerinus	3.40	2	0.71	
Todarodes sagittatus	0.92	2	0.19	
Centrolophus niger	0.60	2	0.13	
Epigonus denticulatus	0.40	12	0.08	
Selachophidium guentheri	0.32	8	0.07	
Laemonema laureysi	0.24	2	0.05	
Bathynectes piperitus	0.16	2	0.03	
Photichthys argenteus	0.16	4	0.03	
Squilla acuelata calmani	0.06	2	0.01	
Total	479.52		100.01	

PROJECT STATION:1452

DATE:23/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2424
start stop duration Long E 1339
TIME :07:46:00 09:58:00 132 (min) Purpose code: 1
LOG :1543.70 1550.60 6.90 Area code : 2
FDEPTH: 345 367 GearCond.code:
BDEPTH: 345 367 Validity code:
Towing dir: 180° Wire out:1000 m Speed: 31 kn*10

Sorted: 614 Kg Total catch: 1093.37 CATCH/HOUR: 496.99

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	199.95	128	40.23	5041
Krill	114.82		23.10	
Helicolenus dactylopterus	57.27	675	11.52	
Merluccius paradoxus	57.25	121	11.52	5042
Centrolophus niger	37.23	27	7.49	
Nezumia sp.	14.05	280	2.83	
Coelorinchus fasciatus	6.07	68	1.22	
Genypterus capensis	4.64	5	0.93	
Galeus polli	2.32	61	0.47	
Lophius vomerinus	2.19	1	0.44	
MYCTOPHIDAE	0.95		0.19	
Trachurus capensis	0.25		0.05	
Total	496.99		99.99	

PROJECT STATION:1453

DATE:23/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2425
start stop duration Long E 1339
TIME :11:42:00 12:12:00 30 (min) Purpose code: 1
LOG :1560.80 1562.30 1.50 Area code : 2
FDEPTH: 320 325 GearCond.code:
BDEPTH: 347 352 Validity code:
Towing dir: 180° Wire out: 820 m Speed: 35 kn*10

Sorted: 445 Kg Total catch: 503.61 CATCH/HOUR: 1007.22

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	766.70	2784	76.12	5044
MYCTOPHIDAE	146.42	20252	14.54	
Merluccius capensis	48.50	34	4.82	5043
Todarodes sagittatus	11.80	8	1.17	
Brama brama	10.26	2	1.02	
Schedophilus huttoni	8.60	2	0.85	
Beryx splendens	6.72	56	0.67	
Lepidopus caudatus	4.32	4	0.43	
Sepia sp.	2.48	296	0.25	
Helicolenus dactylopterus	1.44	16	0.14	
Total	1007.24		100.01	

PROJECT STATION:1454

DATE:23/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2425
start stop duration Long E 1339
TIME :13:20:00 14:10:00 50 (min) Purpose code: 1
LOG :1568.00 157.70 2.70 Area code : 2
FDEPTH: 180 180 GearCond.code:
BDEPTH: 348 356 Validity code:
Towing dir: 180° Wire out: 580 m Speed: 35 kn*10

Sorted: 3 Kg Total catch: 68.03 CATCH/HOUR: 81.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Sepia sp.	45.10	2348	55.24	
Brama brama	19.80	12	24.25	
MYCTOPHIDAE	14.09	1949	17.26	
Todarodes sagittatus	2.65	13	3.25	
Total	81.64		100.00	

PROJECT STATION:1455

DATE:23/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :17:47:00 17:59:00 12 (min) Purpose code: 1
LOG :1585.60 1586.20 0.60 Area code : 2
FDEPTH: 355 357 GearCond.code: 9
BDEPTH: 355 357 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 30 kn*10

Sorted: 147 Kg Total catch: 147.72 CATCH/HOUR: 738.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	421.25	190	57.03	5045
Helicolenus dactylopterus	123.75	200	16.75	
Merluccius paradoxus	113.50	200	15.37	5046
Nezumia sp.	19.70	535	2.67	
Coelorinchus fasciatus	16.35	150	2.21	
Hexanchus griseus	10.80	5	1.46	
Todarodes sagittatus	9.50	15	1.29	
Galeus polli	7.65	350	1.04	
Genypterus capensis	4.00	5	0.54	
Lampanyctodes hectoris	3.65	1660	0.49	
Lophius vomerinus	3.30	5	0.45	
MYCTOPHIDAE	3.15	385	0.43	
Notacanthus sexspinis	0.60	15	0.08	
S H R I M P S	0.55	200	0.07	
Selachophidium guentheri	0.40	15	0.05	
Squilla acuelata calmani	0.30	20	0.04	
Epigonus denticulatus	0.10	5	0.01	
Ebinania costaecanarie	0.05	5	0.01	
Total	738.60		99.99	

PROJECT STATION:1456

DATE:23/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1339
TIME :22:12:00 22:42:00 30 (min) Purpose code: 1
LOG :1605.40 1607.20 1.60 Area code : 2
FDEPTH: 330 335 GearCond.code: 1
BDEPTH: 355 361 Validity code:
Towing dir: 180° Wire out: 860 m Speed: 32 kn*10

Sorted: Kg Total catch: 390.08 CATCH/HOUR: 780.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	394.50	1044	50.57	5047
Merluccius capensis	325.40	156	41.71	5048
Deepwater fish mixture	24.58		3.15	
Genypterus capensis	9.10	8	1.17	5049
MYCTOPHIDAE	8.78	1048	1.13	
Sepia sp.	6.66	2306	0.85	
Epigonus denticulatus	3.38	58	0.43	
Todarodes sagittatus	2.64	10	0.34	
Nezumia sp.	2.16	58	0.28	
Photichthys argenteus	0.88	90	0.11	
Coelorinchus fasciatus	0.80	10	0.10	
Helicolenus dactylopterus	0.48	8	0.06	
Lampanyctodes hectoris	0.40	166	0.05	
Shrimps, small, non comm.	0.22	96	0.03	
Ebinania costaecanarie	0.14	2	0.02	
Notacanthus sexspinis	0.04	2	0.01	
Total	780.16		100.01	

PROJECT STATION:1457

DATE:24/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2428
start stop duration Long E 1339
TIME :00:04:00 00:35:00 31 (min) Purpose code: 1
LOG :1612.57 1614.13 1.56 Area code : 2
FDEPTH: 351 353 GearCond.code:
BDEPTH: 351 353 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 30 kn*10

Sorted: 131 Kg Total catch: 131.12 CATCH/HOUR: 253.78

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	111.87	114	44.08	5051
Merluccius paradoxus	89.71	192	35.35	5050
Helicolenus dactylopterus	33.48	449	13.19	
Nezumia sp.	8.57	170	3.38	
Coelorinchus fasciatus	5.71	103	2.25	
Genypterus capensis	1.47	2	0.58	
Lophius vomerinus	1.08	2	0.43	
MYCTOPHIDAE	0.70	85	0.28	
Galeus polli	0.48	21	0.19	
Notacanthus sexspinis	0.45	6	0.18	
Selachophidium guentheri	0.14	6	0.06	
Shrimps, small, non comm.	0.08	21	0.03	
Ebinania costaecanarie	0.04	4	0.02	
Total	253.78		100.02	

PROJECT STATION:1458

DATE:24/ 4/96 GEAR TYPE: PT No:2 POSITION:Lat S 2427
start stop duration Long E 1339
TIME :01:28:00 02:00:00 32 (min) Purpose code: 1
LOG :1618.39 1620.26 1.87 Area code : 2
FDEPTH: 10 10 GearCond.code:
BDEPTH: 357 362 Validity code:
Towing dir: 180° Wire out: 150 m Speed: 35 kn*10

Sorted: Kg Total catch: 229.60 CATCH/HOUR: 430.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	410.91	50507	95.45	
Taractes sp.	17.72	4	4.12	
SCOMBRIDAE	1.91	9	0.44	
Total	430.54		100.01	

PROJECT STATION:1459

DATE:24/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1339
TIME :03:22:00 03:47:00 25 (min) Purpose code: 1
LOG :1627.35 1628.73 1.38 Area code : 2
FDEPTH: 70 70 GearCond.code:
BDEPTH: 358 363 Validity code:
Towing dir: 180° Wire out: 200 m Speed: 35 kn*10

Sorted: 29 Kg Total catch: 29.40 CATCH/HOUR: 70.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	63.50	25018	89.99	
Krill	7.06		10.01	
Total	70.56		100.00	

PROJECT STATION:1460

DATE:24/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2428
start stop duration Long E 1339
TIME :04:27:00 04:58:00 31 (min) Purpose code: 1
LOG :1630.92 1632.50 1.58 Area code : 2
FDEPTH: 250 250 GearCond.code:
BDEPTH: 359 352 Validity code:
Towing dir: 350° Wire out: 680 m Speed: 35 kn*10

Sorted: 7 Kg Total catch: 29.47 CATCH/HOUR: 57.04

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
MYCTOPHIDAE	49.61	13817	86.97	
Krill	3.66		6.42	
Photichthys argenteus	2.44	269	4.28	
Sepia sp.	0.83	101	1.46	
Thyrsites atun	0.50	2	0.88	
Total	57.04		100.01	

PROJECT STATION:1461

DATE:24/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1339
TIME :06:06:00 06:36:00 30 (min) Purpose code: 1
LOG :1636.80 1638.30 1.50 Area code : 2
FDEPTH: 352 358 GearCond.code:
BDEPTH: 352 358 Validity code:
Towing dir: 180° Wire out:1080 m Speed: 30 kn*10

Sorted: 145 Kg Total catch: 278.72 CATCH/HOUR: 557.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	151.20	1686	27.12	
Merluccius capensis	138.50	50	24.85	5053
Krill	116.64		20.92	
Merluccius paradoxus	68.90	166	12.36	5052
Nezumia sp.	30.48	852	5.47	
Centrolophus niger	24.00	10	4.31	
Coelorinchus fasciatus	12.84	216	2.30	
Lampanyctodes hectoris	3.36		0.60	
Notacanthus sexspinis	3.24	48	0.58	
Todarodes sagittatus	2.48	4	0.44	
Genypterus capensis	1.96	2	0.35	
Galeus polli	1.92	84	0.34	
Epigonus denticulatus	0.72	36	0.13	
Ebinania costaecanarie	0.48	36	0.09	
S H R I M P S	0.48	108	0.09	
Sepia sp.	0.24	48	0.04	
Total	557.44		99.99	

PROJECT STATION:1462

DATE:24/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :08:00:00 08:30:00 30 (min) Purpose code: 1
LOG :1643.70 1645.30 1.60 Area code : 2
FDEPTH: 330 335 GearCond.code: 1
BDEPTH: 353 360 Validity code:
Towing dir: 180° Wire out: 860 m Speed: 32 kn*10

Sorted: 337 Kg Total catch: 652.27 CATCH/HOUR: 1304.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	465.66	1576	35.70	5055
Krill	442.60		33.93	
MYCTOPHIDAE	241.80	26896	18.54	
Merluccius capensis	48.30	32	3.70	5054
Centrolophus niger	26.20	12	2.01	
Trachurus capensis	25.60	42	1.96	5056
Todarodes sagittatus	19.90	52	1.53	
Sepia sp.	19.60	332	1.50	
Epigonus denticulatus	7.54	52	0.58	
Zeus capensis	4.50	4	0.34	
Lepidopus caudatus	2.04	4	0.16	
Helicolenus dactylopterus	0.80	10	0.06	
Total	1304.54		100.01	

PROJECT STATION:1463

DATE:24/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :10:39:00 11:10:00 31 (min) Purpose code: 1
LOG :1654.60 1656.30 1.70 Area code : 2
FDEPTH: 279 280 GearCond.code: 1
BDEPTH: 354 361 Validity code:
Towing dir: 180° Wire out: 760 m Speed: 35 kn*10

Sorted: Kg Total catch: 117.02 CATCH/HOUR: 226.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Lampanyctodes hectoris	88.65	46152	39.14	
MYCTOPHIDAE	88.26	12079	38.97	
Sepia sp.	14.50	2603	6.40	
Todarodes sagittatus	11.03	161	4.87	
Taractes sp.	10.95	2	4.83	
Bregmaceros sp.	7.65	4	3.38	
Centrolophus niger	3.56	2	1.57	
Scopelosaurus meadi	1.12	37	0.49	
Photichthys argenteus	0.77	74	0.34	
Total	226.49		99.99	

PROJECT STATION:1464

DATE:24/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :12:25:00 12:54:00 29 (min) Purpose code: 1
LOG :1661.80 1663.30 1.50 Area code : 2
FDEPTH: 355 361 GearCond.code: 4
BDEPTH: 355 361 Validity code:
Towing dir: 167° Wire out:1050 m Speed: 30 kn*10

Sorted: 34 Kg Total catch: 339.02 CATCH/HOUR: 701.42

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Krill	238.97		34.07	
Merluccius capensis	177.17	83	25.26	5058
Merluccius paradoxus	91.18	163	13.00	5057
Selachophidium guentheri	80.81	37	11.52	
Helicolenus dactylopterus	65.42	819	9.33	
Nezumia sp.	18.87	422	2.69	
Coelorinchus fasciatus	14.28	199	2.04	
Trachurus capensis	5.21	8	0.74	
Notacanthus sexspinis	4.59	62	0.65	
Genypterus capensis	2.07	2	0.30	
Lampanyctodes hectoris	1.12	546	0.16	
Galeus polli	0.62	12	0.09	
Selachophidium guentheri	0.62	25	0.09	
Photichthys argenteus	0.50	12	0.07	
Total	701.43		100.01	

PROJECT STATION:1465

DATE:24/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :13:54:00 14:25:00 31 (min) Purpose code: 1
LOG :1668.10 1669.90 1.80 Area code : 2
FDEPTH: 205 207 GearCond.code: 1
BDEPTH: 355 362 Validity code:
Towing dir: 170° Wire out: 550 m Speed: 35 kn*10

Sorted: 2 Kg Total catch: 89.98 CATCH/HOUR: 174.15

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Sepia sp.	124.95	18304	71.75	
MYCTOPHIDAE	42.74	5917	24.54	
Brama brama	6.46	4	3.71	
Total	174.15		100.00	

PROJECT STATION:1466

DATE:24/ 4/96 GEAR TYPE: PT No:2 POSITION:Lat S 2429
start stop duration Long E 1338
TIME :15:04:00 15:34:00 30 (min) Purpose code: 1
LOG :1671.80 1673.40 1.60 Area code : 2
FDEPTH: 5 5 GearCond.code:
BDEPTH: 362 356 Validity code:
Towing dir: 360° Wire out: 160 m Speed: 35 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
N O C A T C H	0.00			
Total				

PROJECT STATION:1467

DATE:24/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :18:00:00 18:34:00 34 (min) Purpose code: 1
LOG :1678.50 1680.00 1.50 Area code : 2
FDEPTH: 354 360 GearCond.code:
BDEPTH: 354 360 Validity code:
Towing dir: 180° Wire out:1080 m Speed: 30 kn*10

Sorted: 121 Kg Total catch: 170.46 CATCH/HOUR: 300.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	106.41	51	35.37	5059
Helicolenus dactylopterus	80.74	1182	26.84	
Merluccius paradoxus	46.68	95	15.52	5060
Nezumia sp.	26.10	582	8.68	
Coelorinchus fasciatus	17.63	238	5.86	
Genypterus capensis	8.03	9	2.67	
MYCTOPHIDAE	4.66	582	1.55	
Lophius vomerinus	3.58	2	1.19	
Lampanyctodes hectoris	2.86	2224	0.95	
Notacanthus sexspinis	1.69	21	0.56	
Galeus polli	0.79	37	0.26	
Sepia sp.	0.42	116	0.14	
S H R I M P S	0.37	111	0.12	
Ebinania costaecanarie	0.26	32	0.09	
Squilla acuelata calmani	0.21	26	0.07	
Bathynectes piperitus	0.21	5	0.07	
Photichthys argenteus	0.11	5	0.04	
Selachophidium guentheri	0.05	5	0.02	
Total	300.80		100.00	

PROJECT STATION:1470

DATE:25/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :02:04:00 02:33:00 29 (min) Purpose code: 1
LOG :1713.70 1715.10 1.40 Area code : 2
FDEPTH: 357 355 GearCond.code:
BDEPTH: 357 355 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 30 kn*10

Sorted: 72 Kg Total catch: 157.31 CATCH/HOUR: 325.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	114.25	1401	35.10	
Merluccius capensis	52.34	23	16.08	5065
Merluccius paradoxus	48.21	85	14.81	5066
Nezumia sp.	30.50	672	9.37	
Krill	22.76		6.99	
Coelorinchus fasciatus	20.48	354	6.29	
Genypterus capensis	8.23	8	2.53	5067
Notacanthus sexspinis	7.28	126	2.24	
MYCTOPHIDAE	5.36	637	1.65	
Galeus polli	3.99	137	1.23	
Shrimps, small, non comm.	3.87	1059	1.19	
Lampanyctodes hectoris	2.17	1252	0.67	
Lophius vomerinus	2.01	4	0.62	
Selachophidium guentheri	1.72	58	0.53	
Ebinania costaecanarie	0.81	58	0.25	
Epigonus denticulatus	0.68	12	0.21	
Squilla acuelata calmani	0.46	46	0.14	
Hoplostethus cadenati	0.35	12	0.11	
Total	325.47		100.01	

PROJECT STATION:1468

DATE:24/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :19:31:00 20:01:00 30 (min) Purpose code: 1
LOG :1686.90 1688.50 1.60 Area code : 2
FDEPTH: 328 330 GearCond.code: 1
BDEPTH: 355 360 Validity code:
Towing dir: 180° Wire out: 870 m Speed: 32 kn*10

Sorted: 272 Kg Total catch: 290.95 CATCH/HOUR: 581.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	289.10	1042	49.68	5062
Merluccius capensis	241.00	114	41.42	5061
MYCTOPHIDAE	27.60	9200	4.74	
Krill	9.98		1.72	
S H R I M P S	4.82	1988	0.83	
Epigonus denticulatus	4.48	150	0.77	
Sepia sp.	3.82	580	0.66	
Todarodes sagittatus	1.10	2	0.19	
Total	581.90		100.01	

PROJECT STATION:1471

DATE:25/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1339
TIME :05:40:00 06:10:00 30 (min) Purpose code: 1
LOG :1723.10 1724.70 1.60 Area code : 2
FDEPTH: 328 332 GearCond.code: 1
BDEPTH: 355 360 Validity code:
Towing dir: 180° Wire out: 750 m Speed: 32 kn*10

Sorted: 199 Kg Total catch: 297.04 CATCH/HOUR: 594.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	223.70	788	37.65	5068
Merluccius capensis	210.20	110	35.38	5069
Krill	60.20		10.13	
MYCTOPHIDAE	41.20	5086	6.94	
Centrolophus niger	18.20	10	3.06	
Coelorinchus fasciatus	15.28	102	2.57	
Sepia sp.	11.70	1780	1.97	
Todarodes sagittatus	4.90	18	0.82	
Epigonus denticulatus	4.00	100	0.67	
Genypterus capensis	2.50	2	0.42	
Brama brama	2.20	2	0.37	
Total	594.08		99.98	

PROJECT STATION:1469

DATE:25/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :00:06:00 00:36:00 30 (min) Purpose code: 1
LOG :1706.00 1707.60 1.00 Area code : 2
FDEPTH: 329 335 GearCond.code: 1
BDEPTH: 356 362 Validity code:
Towing dir: 175° Wire out: 850 m Speed: 30 kn*10

Sorted: 1 Kg Total catch: 206.68 CATCH/HOUR: 413.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	231.30	114	55.96	5063
Merluccius paradoxus	145.10	466	35.10	5064
Lampanyctodes hectoris	12.76	6370	3.09	
MYCTOPHIDAE	9.06	1250	2.19	
Krill	5.70		1.38	
Sepia sp.	3.86	750	0.93	
Shrimps, small, non comm.	1.86	686	0.45	
Helicolenus dactylopterus	1.50	16	0.36	
Epigonus denticulatus	1.00	50	0.24	
Coelorinchus fasciatus	0.50	36	0.12	
Ebinania costaecanarie	0.36	16	0.09	
Photichthys argenteus	0.36	36	0.09	
Total	413.36		100.00	

PROJECT STATION:1472

DATE:25/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2425
start stop duration Long E 1939
TIME :08:20:00 08:50:00 30 (min) Purpose code: 1
LOG :1731.50 1733.00 1.50 Area code : 2
FDEPTH: 349 356 GearCond.code:
BDEPTH: 349 356 Validity code:
Towing dir: 180° Wire out:1080 m Speed: 30 kn*10

Sorted: Kg Total catch: 300.06 CATCH/HOUR: 600.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	172.20	94	28.69	5070
Helicolenus dactylopterus	126.30	1670	21.05	
Merluccius paradoxus	107.70	230	17.95	5071
Krill	101.50		16.91	
Centrolophus niger	51.70	24	8.61	
Nezumia sp.	10.40	190	1.73	
Lophius vomerinus	7.66	2	1.28	
Coelorinchus fasciatus	7.50	180	1.25	
Lampanyctodes hectoris	3.90		0.65	
Notacanthus sexspinis	2.70	40	0.45	
Lepidopus caudatus	2.50	4	0.42	
Sepia sp.	2.00		0.33	
Todarodes sagittatus	1.96	2	0.33	
Galeus polli	1.40	60	0.23	
Squilla acuelata calmani	0.40	30	0.07	
Epigonus denticulatus	0.30	10	0.05	
Total	600.12		100.00	

PROJECT STATION:1473

DATE:25/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2425
start stop duration Long E 1338
TIME :11:38:00 12:09:00 31 (min) Purpose code: 1
LOG :1738.50 1740.00 1.50 Area code : 2
FDEPTH: 323 328 GearCond.code: 1
BDEPTH: 350 355 Validity code:
Towing dir: 173° Wire out: 800 m Speed: 35 kn*10

Sorted: 2 Kg Total catch: 332.14 CATCH/HOUR: 642.85

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Lampanyctodes hectoris	225.29	117832	35.05	
Merluccius paradoxus	114.97	439	17.88	5073
MYCTOPHIDAE	83.15	10173	12.93	
Taractes rubescens	69.68	14	10.84	
Todarodes sagittatus	46.20	217	7.19	
Sepia sp.	37.32	4924	5.81	
Merluccius capensis	20.61	14	3.21	5072
Trachurus capensis	17.52	29	2.73	5074
Schedophilus huttoni	14.13	8	2.20	
Brama brama	13.55	10	2.11	
Beryx splendens	0.45	4	0.07	
Total	642.87		100.02	

PROJECT STATION:1474

DATE:17/ 7/01 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1337
TIME :14:19:00 14:51:00 32 (min) Purpose code: 1
LOG :1744.60 1746.10 1.50 Area code : 2
FDEPTH: 352 352 GearCond.code:
BDEPTH: 352 352 Validity code:
Towing dir: 209° Wire out: m Speed:105 kn*10

Sorted: 26 Kg Total catch: 437.48 CATCH/HOUR: 820.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	281.06	129	34.26	5076
Merluccius paradoxus	188.21	414	22.94	5075
Krill	138.47		16.88	
Helicolenus dactylopterus	112.09	1326	13.66	
Nezumia sp.	40.82	814	4.98	
Coelorinchus fasciatus	22.71	328	2.77	
Trachipterus jacksonensis	15.62	13	1.90	
Galeus polli	5.51	236	0.67	
Notacanthus sexspinis	4.33	66	0.53	
Genypterus capensis	3.98	4	0.49	5077
Lampanyctodes hectoris	1.84	1352	0.22	
Todarodes sagittatus	1.31	26	0.16	
Selachophidium guentheri	1.31	39	0.16	
MYCTOPHIDAE	1.31	39	0.16	
Epigonus denticulatus	0.92	39	0.11	
Ebinania costaecanarie	0.53	53	0.06	
Shrimps, small, non comm.	0.26	66	0.03	
Squilla acuelata calmani	0.26	13	0.03	
Total	820.54		100.01	

PROJECT STATION:1475

DATE:25/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :17:27:00 17:57:00 30 (min) Purpose code: 1
LOG :1752.60 1754.20 1.60 Area code : 2
FDEPTH: 325 330 GearCond.code:
BDEPTH: 352 358 Validity code:
Towing dir: 180° Wire out: 870 m Speed: 32 kn*10

Sorted: 360 Kg Total catch: 362.14 CATCH/HOUR: 724.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	461.40	196	63.70	5078
Merluccius paradoxus	254.50	612	35.14	5079
Lophius vomerinus	3.18	2	0.44	
Krill	1.80		0.25	
Lampanyctodes hectoris	1.24	620	0.17	
MYCTOPHIDAE	0.76	92	0.10	
Nezumia sp.	0.52	8	0.07	
Lycoteuthis diadema	0.40	76	0.06	
Todarodes sagittatus	0.24	4	0.03	
Shrimps, small, non comm.	0.12	52	0.02	
Coelorinchus fasciatus	0.12	8	0.02	
Total	724.28		100.00	

PROJECT STATION:1476

DATE:26/ 4/96 GEAR TYPE: PT No:1 POSITION:Lat S 2316
start stop duration Long E 1408
TIME :17:43:00 17:44:00 1 (min) Purpose code: 1
LOG :1908.80 1908.90 0.10 Area code : 2
FDEPTH: 50 48 GearCond.code: 1
BDEPTH: 124 124 Validity code:
Towing dir: 204° Wire out: 180 m Speed: 30 kn*10

Sorted: 4 Kg Total catch: 13.47 CATCH/HOUR: 808.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Sufflogobius bibarbatus	795.60	663000	98.44	
Trachurus capensis	7.20	1200	0.89	5081
Todarodes sagittatus	2.40	60	0.30	
Merluccius capensis	2.40	300	0.30	5080
Galeus polli	0.60	60	0.07	
Total	808.20		100.00	

PROJECT STATION:1477

DATE:27/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2355
start stop duration Long E 1350
TIME :06:03:00 06:16:00 13 (min) Purpose code: 1
LOG :1977.70 1978.30 0.60 Area code : 2
FDEPTH: 229 231 GearCond.code:
BDEPTH: 229 231 Validity code:
Towing dir: 220° Wire out: 775 m Speed: 30 kn*10

Sorted: 143 Kg Total catch: 475.71 CATCH/HOUR: 2195.58

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	1532.35	7062	69.79	5082
Trachurus capensis	544.52	2732	24.80	5084
Merluccius capensis, juveniles	54.92	2622	2.50	5083
Chelidonichthys capensis	21.65	46	0.99	
Thyrsites atun	18.05	5	0.82	5085
Lepidopus caudatus	10.34	157	0.47	
Sufflogobius bibarbatus	6.60	674	0.30	
Pterothrissus belloci	3.14	32	0.14	
Todarodes sagittatus	2.91	5	0.13	
Coelorinchus fasciatus	1.11	32	0.05	
Total	2195.59		99.99	

PROJECT STATION:1478

DATE:27/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2408
start stop duration Long E 1426
TIME :10:34:00 12:21:00 107 (min) Purpose code: 1
LOG :2016.80 1221.00 5.80 Area code : 2
FDEPTH: 44 44 GearCond.code:
BDEPTH: 44 44 Validity code: 9
Towing dir: 352° Wire out: 250 m Speed: 14 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
N O C A T C H	0.00			
Total				

PROJECT STATION:1479

DATE:27/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2357
start stop duration Long E 1359
TIME :15:57:00 16:04:00 7 (min) Purpose code: 1
LOG :2049.20 2049.70 0.50 Area code : 1
FDEPTH: 210 210 GearCond.code:
BDEPTH: 210 210 Validity code:
Towing dir: 350° Wire out: 700 m Speed: 30 kn*10

Sorted: Kg Total catch: 519.60 CATCH/HOUR: 4453.71

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	4453.71	45051	100.00	5086
Total	4453.71		100.00	

PROJECT STATION:1480

DATE:28/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2405
start stop duration Long E 1323
TIME :11:24:00 11:55:00 31 (min) Purpose code: 1
LOG :2125.60 2127.30 1.70 Area code : 2
FDEPTH: 298 298 GearCond.code:
BDEPTH: 298 298 Validity code: 9
Towing dir: 144° Wire out: 870 m Speed: 35 kn*10

Sorted: Kg Total catch: 29.01 CATCH/HOUR: 56.15

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Lampanyctodes hectoris	18.25	10736	32.50	
Trachurus capensis	13.55	35	24.13	5088
Helicolenus dactylopterus	10.97	163	19.54	
Merluccius capensis	6.77	19	12.06	5087
Brama brama	2.42	2	4.31	
Lepidopus caudatus	1.82	14	3.24	
Beryx splendens	1.41	15	2.51	
Todarodes sagittatus	0.85	4	1.51	
Galeus polli	0.06	2	0.11	
Bassanago albescens	0.04	2	0.07	
Total	56.14		99.98	

PROJECT STATION:1481

DATE:28/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2405
start stop duration Long E 1323
TIME :12:49:00 13:19:00 30 (min) Purpose code: 1
LOG :2132.20 2133.70 1.50 Area code : 2
FDEPTH: 303 303 GearCond.code:
BDEPTH: 303 303 Validity code: 9
Towing dir: 147° Wire out: 920 m Speed: 30 kn*10

Sorted: 12 Kg Total catch: 261.73 CATCH/HOUR: 523.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	172.80	3336	33.01	
Trachurus capensis	124.80	322	23.84	5091
Merluccius paradoxus	93.70	656	17.90	5090
Merluccius capensis	93.00	336	17.77	5089
Lampanyctodes hectoris	12.12	5130	2.32	
Todarodes sagittatus	6.20	112	1.18	
Chlorophthalmus atlanticus	5.70	540	1.09	
Brama brama	5.42	4	1.04	
Coelorinchus fasciatus	2.34	54	0.45	
Beryx splendens	1.62	12	0.31	
Squilla acuelata calmani	1.56	54	0.30	
MYCTOPHIDAE	1.44	138	0.28	
Lepidopus caudatus	1.44	24	0.28	
Lophius vomerinus	1.02	2	0.19	
Malacocephalus laevis	0.30	6	0.06	
Total	523.46		100.02	

PROJECT STATION:1482

DATE:28/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2402
start stop duration Long E 1401
TIME :17:37:00 18:07:00 30 (min) Purpose code: 1
LOG :2174.22 2176.04 1.82 Area code : 2
FDEPTH: 193 193 GearCond.code:
BDEPTH: 198 196 Validity code:
Towing dir: 176° Wire out: 580 m Speed: 33 kn*10

Sorted: 8 Kg Total catch: 60.00 CATCH/HOUR: 120.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	111.06	2936	92.55	5092
Sufflogobius bibarbatus	8.92	4264	7.43	
Total	119.98		99.98	

PROJECT STATION:1483

DATE:28/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2419
start stop duration Long E 1345
TIME :21:08:00 21:38:00 30 (min) Purpose code: 1
LOG :2199.71 2201.19 1.48 Area code : 2
FDEPTH: 305 306 GearCond.code:
BDEPTH: 308 315 Validity code:
Towing dir: 221° Wire out: 88 m Speed: 30 kn*10

Sorted: 132 Kg Total catch: 184.58 CATCH/HOUR: 369.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	163.20	144	44.21	5093
Helicolenus dactylopterus	128.10	3842	34.70	
Merluccius paradoxus	38.40	184	10.40	5094
Coelorinchus fasciatus	18.84	378	5.10	
Trachurus capensis	7.40	26	2.00	5096
MYCTOPHIDAE	4.44		1.20	
Krill	3.30		0.89	
Squilla acuelata calmani	1.74	72	0.47	
Genypterus capensis	1.70	4	0.46	5095
Nezumia sp.	1.62	90	0.44	
Galeus polli	0.42	12	0.11	
Total	369.16		99.98	

PROJECT STATION:1484

DATE:28/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2419
start stop duration Long E 1344
TIME :22:49:00 23:19:00 30 (min) Purpose code: 2
LOG :2206.55 2208.27 1.72 Area code : 2
FDEPTH: 310 310 GearCond.code:
BDEPTH: 310 310 Validity code:
Towing dir: 220° Wire out: 820 m Speed: 33 kn*10

Sorted: 20 Kg Total catch: 114.77 CATCH/HOUR: 229.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	94.20	78	41.04	5098
Helicolenus dactylopterus	73.60	1908	32.06	
Merluccius paradoxus	34.20	150	14.90	5097
Krill	8.32		3.62	
Coelorinchus fasciatus	6.50	176	2.83	
Lampanyctodes hectoris	5.94	3296	2.59	
Trachurus capensis	2.28	8	0.99	5099
MYCTOPHIDAE	1.62	182	0.71	
Nezumia sp.	1.34	76	0.58	
Galeus polli	0.96	28	0.42	
Squilla acuelata calmani	0.34	14	0.15	
Epigonus denticulatus	0.14	4	0.06	
Bathynectes piperitus	0.10	10	0.04	
Total	229.54		99.99	

PROJECT STATION:1485

DATE:29/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1339
TIME :00:33:00 01:03:00 30 (min) Purpose code: 1
LOG :2215.70 2217.10 1.40 Area code : 2
FDEPTH: 349 357 GearCond.code: 1
BDEPTH: 349 357 Validity code:
Towing dir: 168° Wire out:1050 m Speed: 30 kn*10

Sorted: 21 Kg Total catch: 276.91 CATCH/HOUR: 553.82

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	216.46	100	39.08	5100
Merluccius paradoxus	199.44	304	36.01	5101
Helicolenus dactylopterus	77.40	1050	13.98	
Krill	22.50		4.06	
Coelorinchus fasciatus	9.24	168	1.67	
Nezumia sp.	7.02	132	1.27	
Centrolophus niger	6.24	6	1.13	
Trachurus capensis	3.24	10	0.59	5102
Galeus polli	2.82	60	0.51	
MYCTOPHIDAE	2.82	426	0.51	
Genypterus capensis	2.06	2	0.37	5103
Shrimps, small, non comm.	1.38	378	0.25	
Todarodes sagittatus	0.98	2	0.18	
Notacanthus sexspinis	0.72	12	0.13	
Epigonus denticulatus	0.60	24	0.11	
Epigonus telescopus	0.36	6	0.07	
Squilla acuelata calmani	0.18	6	0.03	
Bathynectes piperitus	0.18	6	0.03	
Selachophidium guentheri	0.18	18	0.03	
Total	553.82		100.01	

PROJECT STATION:1486

DATE:29/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E :339
TIME :01:59:00 02:29:00 30 (min) Purpose code: 1
LOG :2221.80 2223.60 1.80 Area code : 2
FDEPTH: 347 354 GearCond.code: 1
BDEPTH: 347 354 Validity code:
Towing dir: 164° Wire out: 950 m Speed: 35 kn*10

Sorted: 26 Kg Total catch: 261.45 CATCH/HOUR: 522.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	212.80	284	40.70	5105
Merluccius capensis	171.50	76	32.80	5104
Helicolenus dactylopterus	102.50	1450	19.60	
Coelorinchus fasciatus	10.10	86	1.93	
Krill	8.66		1.66	
Genypterus capensis	6.80	6	1.30	5106
Nezumia sp.	4.30	90	0.82	
MYCTOPHIDAE	1.66	166	0.32	
Galeus polli	1.10	20	0.21	
Notacanthus sexspinis	0.96	20	0.18	
Todarodes sagittatus	0.78	2	0.15	
Lampanyctodes hectoris	0.60	406	0.11	
Shrimps, small, non comm.	0.26	76	0.05	
Bathynectes piperitus	0.20	16	0.04	
Selachophidium guentheri	0.20	20	0.04	
Ebinania costaecanarie	0.16	16	0.03	
Epigonus denticulatus	0.16	6	0.03	
Sepia sp.	0.10	10	0.02	
Squilla acuelata calmani	0.06	6	0.01	
Total	522.90		100.00	

PROJECT STATION:1487

DATE:29/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :16:10:00 16:41:00 31 (min) Purpose code: 1
LOG :2250.75 2252.23 1.48 Area code : 2
FDEPTH: 347 351 GearCond.code:
BDEPTH: 355 361 Validity code: 9
Towing dir: 173° Wire out:1050 m Speed: 30 kn*10

Sorted: 19 Kg Total catch: 223.30 CATCH/HOUR: 432.19

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	154.65	77	35.78	5107
Merluccius paradoxus	133.35	242	30.85	5108
Deepwater fish mixture	73.88		17.09	
Helicolenus dactylopterus	52.90	639	12.24	
Genypterus capensis	12.68	10	2.93	5109
Lophius vomerinus	4.74	4	1.10	5110
Total	432.20		99.99	

PROJECT STATION:1488

DATE:29/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2431
start stop duration Long E 1338
TIME :17:59:00 18:29:00 30 (min) Purpose code: 2
LOG :2257.10 2258.70 1.60 Area code : 2
FDEPTH: 371 377 GearCond.code:
BDEPTH: 371 377 Validity code:
Towing dir: 180° Wire out:1100 m Speed: 32 kn*10

Sorted: 31 Kg Total catch: 287.75 CATCH/HOUR: 575.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	277.90	474	48.29	5112
Helicolenus dactylopterus	181.60	1648	31.56	
Deepwater fish mixture	70.80		12.30	
Merluccius capensis	41.40	18	7.19	5111
Genypterus capensis	3.80	4	0.66	5113
Total	575.50		100.00	

PROJECT STATION:1489

DATE:29/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1339
TIME :21:05:00 21:36:00 31 (min) Purpose code: 2
LOG :2273.20 2274.85 1.65 Area code : 2
FDEPTH: 354 360 GearCond.code:
BDEPTH: 354 360 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 33 kn*10

Sorted: 30 Kg Total catch: 314.80 CATCH/HOUR: 609.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	309.39	157	50.78	5114
Deepwater fish mixture	123.10		20.20	
Helicolenus dactylopterus	114.19	1316	18.74	
Merluccius paradoxus	52.94	161	8.69	5115
Genypterus capensis	7.55	6	1.24	5116
Lophius vomerinus	1.26	2	0.21	5118
Trachurus capensis	0.87	2	0.14	5117
Total	609.30		100.00	

PROJECT STATION:1490

DATE:29/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2429
start stop duration Long E 1339
TIME :22:59:00 23:29:00 30 (min) Purpose code: 2
LOG :2278.16 2279.61 1.45 Area code : 2
FDEPTH: 362 367 GearCond.code:
BDEPTH: 362 367 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 29 kn*10

Sorted: 32 Kg Total catch: 348.50 CATCH/HOUR: 697.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	392.80	502	56.36	5120
Helicolenus dactylopterus	110.10	1164	15.80	
Merluccius capensis	87.70	38	12.58	5119
Deepwater fish mixture	83.10		11.92	
Lophius vomerinus	12.00	8	1.72	5121
Genypterus capensis	11.30	8	1.62	5122
Total	697.00		100.00	

PROJECT STATION:1491

DATE:30/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :05:04:00 05:34:00 30 (min) Purpose code: 1
LOG :2289.14 2290.70 1.56 Area code : 2
FDEPTH: 351 357 GearCond.code:
BDEPTH: 351 357 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 32 kn*10

Sorted: 28 Kg Total catch: 168.78 CATCH/HOUR: 337.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius capensis	119.40	60	35.37	5123
Helicolenus dactylopterus	82.50	1060	24.44	
Merluccius paradoxus	68.30	192	20.23	5124
Deepwater fish mixture	59.76		17.70	
Genypterus capensis	6.50	6	1.93	
Lophius vomerinus	1.10	2	0.33	
Total	337.56		100.00	

PROJECT STATION:1492

DATE:30/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2431
start stop duration Long E 1338
TIME :06:51:00 07:21:00 30 (min) Purpose code: 2
LOG :2294.27 2295.87 1.60 Area code : 2
FDEPTH: 368 375 GearCond.code:
BDEPTH: 368 375 Validity code:
Towing dir: 180° Wire out:1050 m Speed: 32 kn*10

Sorted: 32 Kg Total catch: 327.70 CATCH/HOUR: 655.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Deepwater fish mixture	240.60		36.71	
Merluccius paradoxus	235.30	364	35.90	5126
Helicolenus dactylopterus	149.40	1464	22.80	
Merluccius capensis	20.90	10	3.19	5125
Genypterus capensis	7.50	6	1.14	
Lophius vomerinus	1.70	2	0.26	
Total	655.40		100.00	

PROJECT STATION:1493

DATE:30/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2430
start stop duration Long E 1338
TIME :09:30:00 10:00:00 30 (min) Purpose code: 2
LOG :2303.40 2305.03 1.63 Area code : 2
FDEPTH: 366 361 GearCond.code:
BDEPTH: 366 361 Validity code:
Towing dir: 360° Wire out:1080 m Speed: 32 kn*10

Sorted: 158 Kg Total catch: 270.09 CATCH/HOUR: 540.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	228.70	410	42.34	5128
Deepwater fish mixture	124.20		22.99	
Helicolenus dactylopterus	102.60	1378	18.99	
Merluccius capensis	76.80	32	14.22	5127
Genypterus capensis	5.78	6	1.07	5129
Centrolophus niger	1.26	2	0.23	
Scomber japonicus	0.84	2	0.16	
Total	540.18		100.00	

PROJECT STATION:1494

DATE:30/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2427
start stop duration Long E 1338
TIME :14:02:00 14:32:00 30 (min) Purpose code: 1
LOG :2318.68 2320.27 1.59 Area code : 2
FDEPTH: 355 350 GearCond.code: 1
BDEPTH: 355 350 Validity code:
Towing dir: 20° Wire out: 936 m Speed: 32 kn*10

Sorted: 86 Kg Total catch: 133.92 CATCH/HOUR: 267.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Deepwater fish mixture	78.64		29.36	
Merluccius paradoxus	78.60	158	29.35	5131
Merluccius capensis	52.90	34	19.75	5130
Helicolenus dactylopterus	35.80	332	13.37	
Krill	9.84		3.67	
Nezumia sp.	3.24	48	1.21	
Genypterus capensis	2.64	2	0.99	5132
Epigonus denticulatus	1.72	80	0.64	
Todarodes sagittatus	1.66	6	0.62	
Sepia sp.	0.60	164	0.22	
Lampanyctodes hectoris	0.60	380	0.22	
Notacanthus sexspinis	0.56	4	0.21	
Coelorinchus fasciatus	0.36	8	0.13	
MYCTOPHIDAE	0.24	40	0.09	
Galeus polli	0.20	16	0.07	
Lepidopus caudatus	0.12	8	0.04	
Yarrella blackfordi	0.08	24	0.03	
Photichthys argenteus	0.04	4	0.01	
Total	267.84		99.98	

PROJECT STATION:1495

DATE:30/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :15:37:00 16:07:00 30 (min) Purpose code: 1
LOG :2325.83 2327.29 1.46 Area code : 2
FDEPTH: 354 349 GearCond.code: 1
BDEPTH: 354 349 Validity code:
Towing dir: 10° Wire out:1050 m Speed: 29 kn*10

Sorted: 29 Kg Total catch: 210.37 CATCH/HOUR: 420.74

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Merluccius paradoxus	144.60	234	34.37	5134
Helicolenus dactylopterus	112.20	1488	26.67	
Merluccius capensis	65.50	38	15.57	5133
Lophius vomerinus	25.80	6	6.13	5135
Krill	19.08		4.53	
Nezumia sp.	11.76	234	2.80	
Coelorinchus fasciatus	10.32	186	2.45	
Centrolophus niger	8.64	6	2.05	
Galeus polli	7.80	162	1.85	
Genypterus capensis	5.10	4	1.21	5136
S H R I M P S	2.46	180	0.58	
Epigonus denticulatus	1.98	84	0.47	
Lampanyctodes hectoris	1.92	1122	0.46	
Notacanthus sexspinis	1.44	30	0.34	
Sepia sp.	0.84	204	0.20	
Selachophidium guentheri	0.66	12	0.16	
Yarrella blackfordi	0.42	54	0.10	
Squilla acuelata calmani	0.12	6	0.03	
Todarodes sagittatus	0.10	2	0.02	
Total	420.74		99.99	

PROJECT STATION:1496

DATE:30/ 4/96 GEAR TYPE: BT No:9 POSITION:Lat S 2426
start stop duration Long E 1338
TIME :17:14:00 17:44:00 30 (min) Purpose code: 2
LOG :2332.72 2334.40 1.68 Area code : 2
FDEPTH: 354 348 GearCond.code:
BDEPTH: 354 348 Validity code:
Towing dir: 10° Wire out: 936 m Speed: 34 kn*10

Sorted: Kg Total catch: 68.62 CATCH/HOUR: 137.24

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP.NO.
Helicolenus dactylopterus	34.34	386	25.02	
Merluccius paradoxus	23.70	62	17.27	5138
Merluccius capensis	18.00	10	13.12	5137
Coelorinchus fasciatus	17.96	2786	13.09	
Genypterus capensis	12.60	6	9.18	5139
Nezumia sp.	10.88	154	7.93	
Galeus polli	4.34	146	3.16	
Epigonus telescopus	3.82	118	2.78	
MYCTOPHIDAE	3.34	334	2.43	
Krill	3.30		2.40	
Notacanthus sexspinis	1.46	18	1.06	
Squalus megalops	1.44	4	1.05	
Squilla acuelata calmani	0.66	118	0.48	
Bathynectes piperitus	0.52	18	0.38	
Todarodes sagittatus	0.36	4	0.26	
Ebinania costaecanarie	0.20	10	0.15	
S H R I M P S	0.16	40	0.12	
Sepia sp.	0.16	32	0.12	
Total	137.24		100.00	

CRUISE REPORTS 'DR. FRIDTJOF NANSEN'

SURVEYS OF THE FISH RESOURCES OF NAMIBIA

Cruise Report No 2/96

Part II

Abundance estimation and ecology of 0-group hake (*Merluccius capensis*)

2 - 13 May 1996

by

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Institute of Marine Research
Bergen, 1996

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CHAPTER 1 INTRODUCTION

1.1 Background and objectives

Studies on the abundance and distribution of juvenile fish are an important tool for fishery management. They in fact provide an early indication of recruitment strength and thus on the possible development of stock abundance. Furthermore, understanding the key environmental factors affecting the early life history of the resources exploited might provide powerful instruments to forecast trends in population abundance. Such studies are at present not available for Namibian hake. Following observations of large aggregations of juvenile (0-group) hake off the central Namibian shelf during previous surveys with the RV 'Dr. Fridtjof Nansen' (see for example Anon., 1991), the present survey was planned to map the occurrence of these concentrations and carry out studies on the environmental conditions and ecology of this age-group. Previous studies on distribution and ecology of juvenile hake off Namibia are extremely scarce. Chapowski and Krzeptowski (1980) report on a recruitment survey carried out in 1979 by the Polish RV 'Wiekzno'. The results from that survey indicate that the 0-group was mainly distributed in the area between Dune Point (about 20°S) and Easter Point (about 25°30'S), the densest concentrations were between Cape Cross and Walvis Bay and in the region Easter Point - Hollands Bird Island, at depths of about 100 to 250 m depth.

The central Namibian shelf includes some of the main spawning grounds for hake, particularly between Walvis Bay and Hollands Bird Island (Assorov and Berembein, 1983). Significant year to year variability in peak spawning in this region has been observed, varying from early spring to the late summer. Based on a survey carried out in September - October 1995 Sundby and O'Toole (1995), found that highest concentrations of eggs were below 100 metres. Here they are subject to a strong onshore transport and brought up to the surface in the inshore regions. Highest concentrations of hake larvae where found in the coastal areas around Cape Cross. The Walvis Bay area was also identified by O'Toole (1978) as a major nursery area for hake larvae. After a few months from hatching, at a size of about 10 cm, juvenile hake change from a pelagic to a demersal mode of life (Wysokinski, 1983).

The environmental conditions in this region and their dynamics must play an important role in the early life history of hake and thus contribute to the success or failure of a given year-class.

The present survey aims at gaining a better understanding of the environmental conditions in the above area, estimating the abundance of 0-group hake and study its distribution in relation to the environment. These aims are specified as follows:

- Study the distribution and abundance of juvenile hake with the acoustic method;
- Describe the environmental conditions;
- Carry out target strength measurements;
- Study juvenile hake ecological preferences (environmental conditions, zooplankton abundance and distribution);
- Determine the main predators;
- Carry out physiological studies to identify mechanisms for adaptations to anoxic waters

1.2 Participants

The scientific staff consisted of:

From NatMIRC, Swakopmund (Namibia):
Frances DEALIE, Hashali HAMUKUAYA, Mick O'TOOLE, Jeremiah TITUS and Shaun WELLS.

From , Sea Fisheries Research Station, Lüderitz (Namibia):
Jean-Paul ROUX.

From The Marine Science Research Centre, State University of New York:
Peter WOODHEAD.

From IMR, Bergen (Norway):
Gabriella BIANCHI, Svein FLOEN, Ingvald SVELLINGEN and Jan Arne VAAGENES.

1.3 Narrative

The vessel left Walvis Bay on May 3 and steamed southwards to 24°S (Conception Bay), where the survey started. The survey track consisted of transects perpendicular to the coast and about 20 nautical miles (NM) apart. Bongo hauls were spaced 10 NM from each other, CTD stations 20 NM, along the transects. On the evening of May 3 the vessel met 'Welwitchia' and SCANMAR equipment was installed to test its new bottom trawl. The two vessels met again the next day at about 14.00 hrs. to recover the equipment. After the first three transects were completed it was decided that they should be prolonged to reach about 10 NM beyond the 200 m isobath. This was due to the preliminary observation that juvenile

hake and euphausiids (possibly the main food item of juvenile hake) were caught mainly at the edge of the shelf. After a complete coverage of the area, and a provisional analysis of the data collected, it was decided to continue on the deeper part of shelf and upper slope where most of the juvenile hake had been observed in the first part of the survey. Parallel day-night transects covered the depths 130 to 250 m. Random bottom sampling was performed during daytime while sampling on acoustic targets was performed both during daytime and nighttime to gain information on the horizontal and vertical distribution of 0-group hake. The vessel returned to Walvis Bay on 13 May. Figure 1 shows the cruise track and the sampled stations.

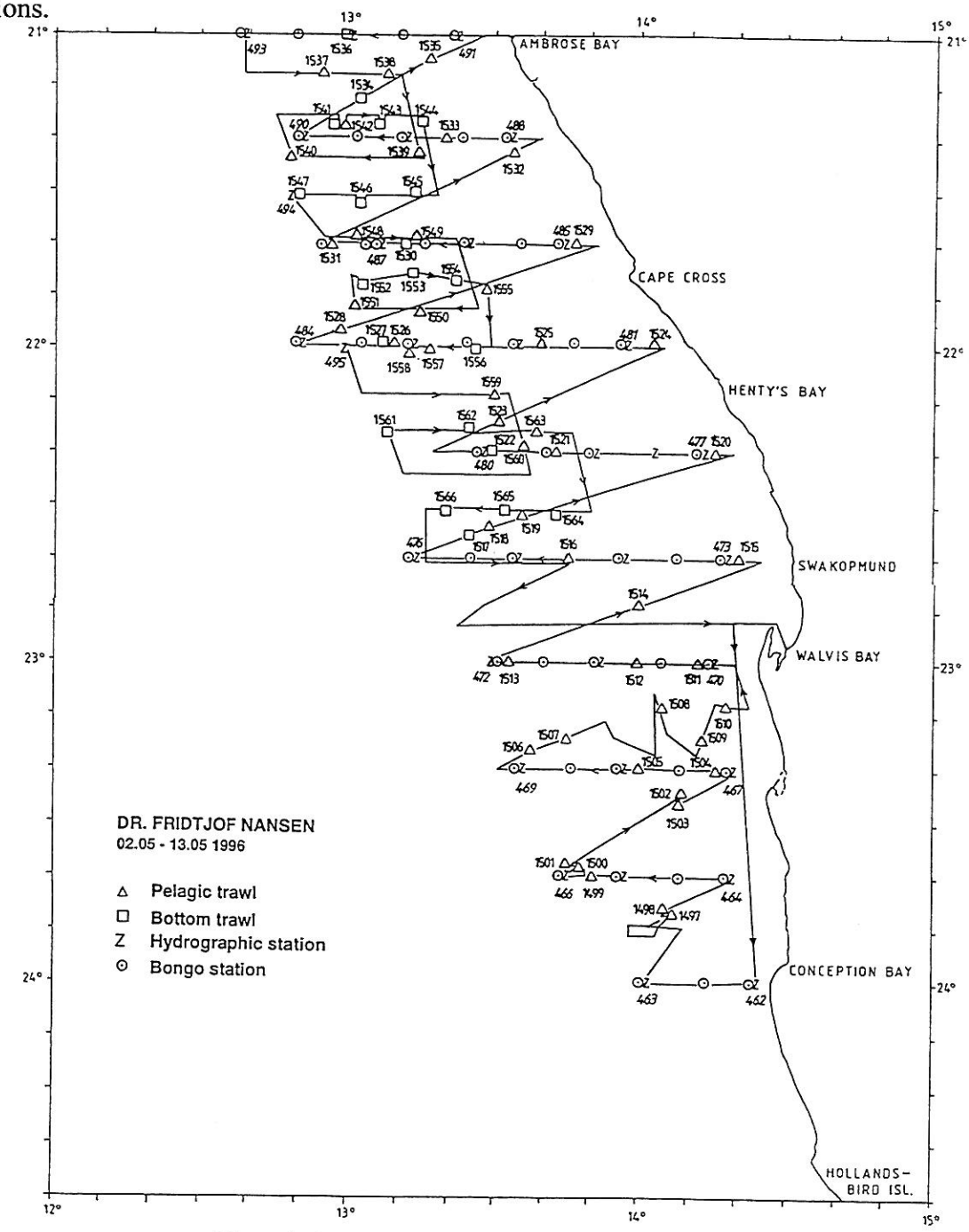


Figure 1. Cruise track and position of sampling stations

CHAPTER 2 METHODS

2.1 Hydrographic sampling

A Seabird 911 CTD plus was used to obtain a general overview and standard vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The profiles were taken down to a few metres above the bottom. Calibration of the CTD equipment for oxygen and salinity values is usually performed by collecting water samples with Niskin bottles. This calibration was not performed and the previous parameters were used. Water samples have been collected and will be analysed at NATMIRC (Swakopmund).

Meteorological observations

Wind (direction and speed), air temperature, global radiation and sea surface temperature (5 m depth) were logged automatically every nautical mile using an Aanderaa meteorological station.

2.2 Zooplankton sampling

Plankton samples were collected using a paired Bongo net, 57 cm in diameter with mesh sizes of #500 mm and a mouth area of 0.25 m^2. One of the nets was fitted with a TSK flowmeter to measure the volume of water filtered. A Scanmar sensor was attached to the frame to provide information on the fishing depth of the net.

Oblique plankton hauls were made in the 0 - 50 m layer by lowering the net from the surface to a depth of 50 m at a rate of about 80 cm/sec while maintaining the wire angle at about 45 degrees. Once the required depth was reached, the net was allowed to stabilise for about 30 seconds before being retrieved at a rate of about 50 cm/sec. Tows were taken during both day and night while the vessel maintained a speed of about 2 knots. After each haul, the contents of one of the nets was examined. All jellyfish larger than 2 cm were identified as far as possible counted, and then discarded. The remaining plankton was then concentrated and transferred to a dish for examination under binocular microscope.

The general contents of each plankton haul was noted and the dominant groups such as copepods and euphausiids were recorded. After removal of further jellyfish fragments, the wet volume of the plankton sample was determined using a graduated 50 ml cylinder. The abundance of plankton was expressed as the volume collected per cubic metre of water filtered. Once the samples were analysed and the volume determined, the plankton was preserved in 5% formalin and stored. Annex I shows the station data for the Bongo hauls and Annex II shows a general description of the plankton samples.

2.3 Fish sampling

According standard notation, 0-group hake is fish caught in the year they were hatched and an average length of about 8 cm, while 0+ group, is all the fish younger than 12 months corresponding to lengths of about 8 to 20 cm, with a mode of 13-14 cm (Wysokinski,1983). This definition has been adopted in this report.

The pelagic trawl was used for target identification of the echo-traces, while bottom trawl was used to sample the occurrence of juvenile hake near the bottom, especially during the second part of the survey. The catches were sampled for species composition, by weight and numbers. Length was measured for target or particularly abundant species. Stomachs and otoliths of juvenile hake were preserved for further analysis. Records of fishing stations are presented in Annex III.

A description of the acoustic instruments and their standard settings is given in Annex IV. This also includes a description of the fishing gear used.

The mean integrator values in each sampling unit (S_A-values) were divided between the following categories of fish on the basis of trawl catches and characteristics of the echo traces:

- gobies (*S. bibarbatus*)
- horse mackerel (*T. capensis*)
- hake (0-group only)
- round herring
- plankton
- mesopelagic fish (mainly Myctophidae)

Physiological samples

Swimbladder gas was collected from freshly caught fish for analysis of oxygen contents. Collections of about 5 ml gas were made in clean glass syringes. The gas samples were injected directly into a flow-through system, to pass a micro electrode calibrated for oxygen determination. Oxygen calibrations were checked after every ten determinations, to detect any drift in electrode potentials. During the cruise the gas analysis methodology was modified and scaled-down to accommodate gas volumes collected from swim bladders of small fish. The modifications allowed analyses to be made satisfactorily on 0.5 ml of gas.

2. 4 Seal counting

The aim of this part of the work was to test methods to estimate the density of fur seals at sea and relate the seal distribution and density with that of their potential preys. A "*half strip transect*" method (similar in principle to strip transect methods used for cetacean observations) has been used: while the ship was cruising at constant speed, all seals detected on one side of the ship's route were noted and the perpendicular distance was estimated. The chosen sampling unit was a period of 10 min while the ship was cruising at approximately 10 Kts (18.5 km/h), covering a distance of 3.09 km in 10 min. Using the ship's log the true speed and distance covered can then be corrected for each count. All observations were conducted from the bridge deck, which gave a near 360 degrees visibility with a viewing height of about 15 m above sea level.

Two devices were used to measure the perpendicular distances of the seal sighted to the ship's route:

- An optical range finder was found to be satisfactory and precise at short range (generally less than 200 m), but extremely difficult to use as soon as the sea was not calm and not accurate enough for long distances;
- A simple measuring device, as illustrated in Figure 2, allowed us to measure distances consistently in a wide range of sea and wind conditions with an acceptable precision up to about 1500 m. Viewing height was measured in harbour as 15.06 m, and the distance from the device was 1.5 m, the readings on the scale of the device were made to the nearest cm. The distance D from the ships side can then be calculated as:

$$D = (d H / h) - d$$

D: distance of the seal in m

d: distance from the measuring device = 1.5 m

H: viewing height above sea level = 15.06 m

h: measured distance on the scale between the horizon line and the line of sight to the seal expressed in metres.

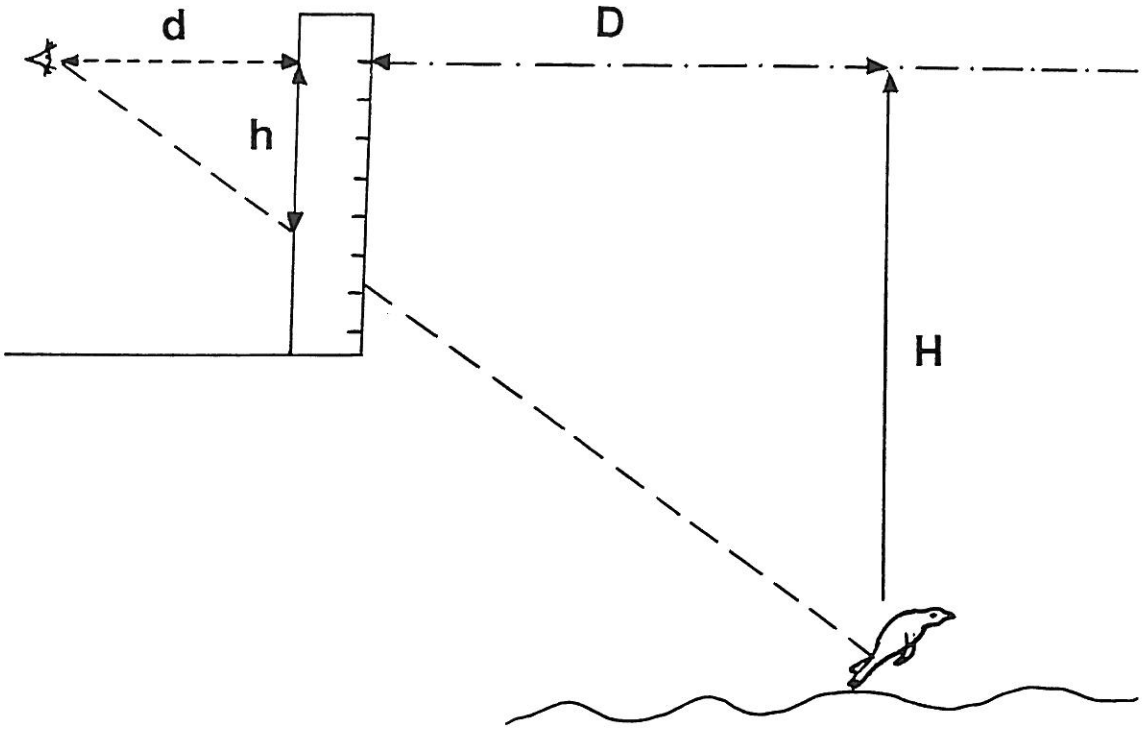


Figure 2. Diagram of the device used to measure seal sighting distances from the ship's side. The distance is calculated by the following equation: D = (d H / h) - d where: D= distance of the seal in m, d= distance from the measuring device = 1.5 m, H: viewing height above sea level = 15.06 m, and h: reading on the scale of the device.

The frequency distribution of the measured distances can then be modelled to calculate the width of the strip effectively sampled and from that the area. The results will obviously only be an index of density as all seals cannot be expected to be detected since they spend a fair proportion of the time at sea diving. On the other hand this index can be used to compare different areas.

Other information noted was related to the behaviour of the seals which might give indications of the different activities (mainly to try to discern between seals in transit between the colony and the feeding areas and seals involved in feeding). These observations were divided in the following categories:

- resting at the surface or grooming
- slow swimming
- fast swimming or porpoising
- feeding

In addition, the size of the groups was noted.

During trawling operations, the numbers and behaviour of the seals attending was noted separately.

2. 5 Seabird observations

Seabirds are well known as good indicators of fish concentrations and oceanographic features. They are in fact potential predators for a number of fish species. Seabird distribution was therefore included in this study to evaluate the potential impact on fish aggregations as well as their value as biological indicators on the Namibian shelf.

Seabirds were identified and counted from the bridge deck using 10x40 binoculars and a tally counter when necessary. All birds present around the ship per period of 10 min were counted using the following categories:

- flying fast
- sitting on the water
- feeding on the surface
- diving
- following or accompanying the ship

For several species (penguins, 3 species of albatrosses, Cape gannets and kelp gulls) it was possible to note the age class from plumage features as well as bill colouration. In addition, the number and behaviour of the birds attending the sampling stations (trawling, bongo nets and hydrographic) were noted separately.

Many of the seabird observations could be made concurrently with the seal counts and the general distributions of the "10 min stations" is presented in Figure 3.

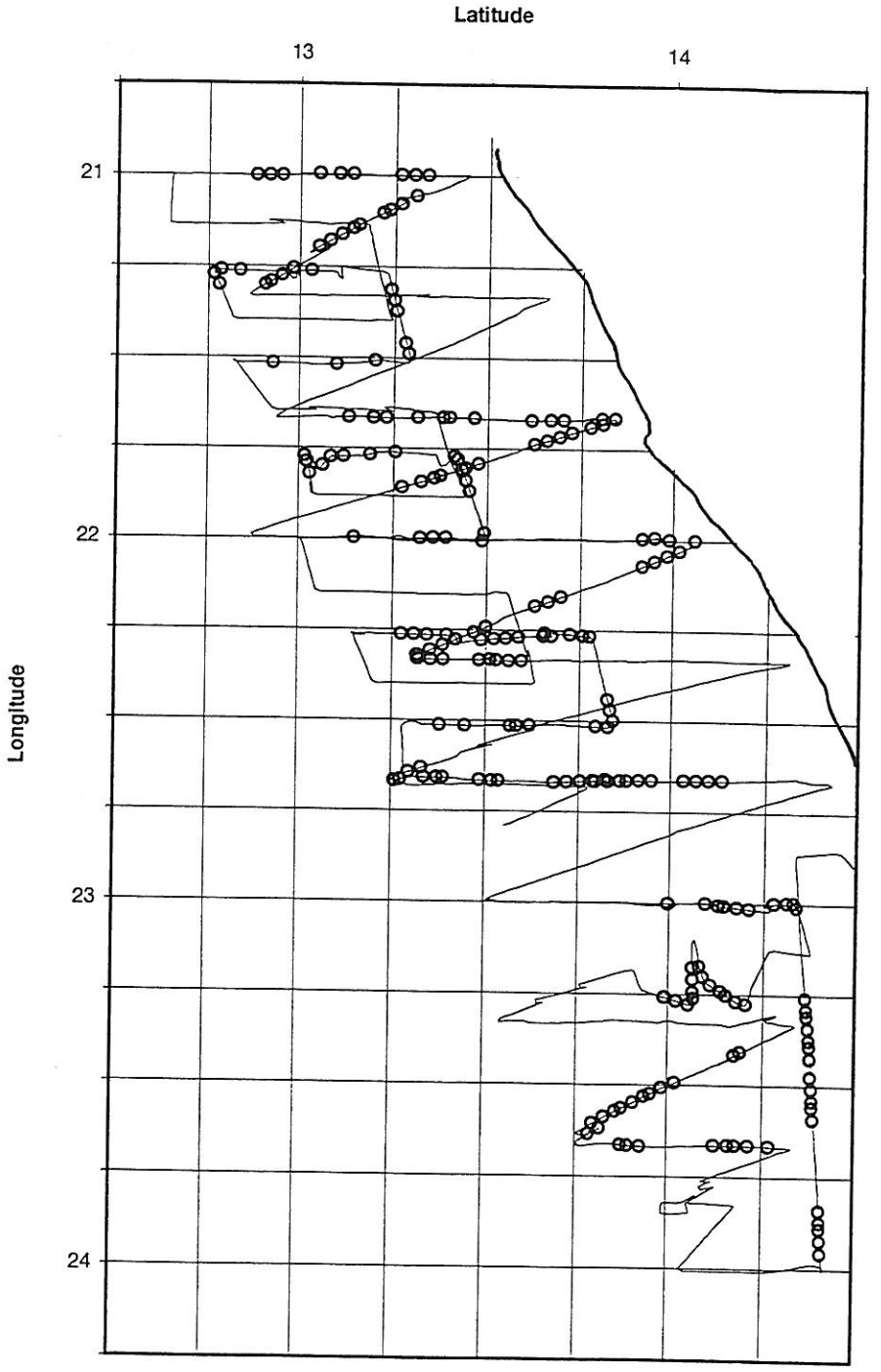


Figure 3. Distribution of the "10 min counts" for seal and seabird counts along the ship's route. Observations could be made only during daylight hours, from about 06:15 to 17:35.

CHAPTER 3 RESULTS

3.1 General hydrographic conditions

Figure 4 shows selected vertical profiles of temperature and oxygen at different latitudes in the survey area. The general structure is characterised by a rather static situation, with a stratified water column and no signs of upwelling. The temperature profiles show some mixing in the upper 20-30 metres, near the coast. Figure 5 shows the surface temperature which confirms the perception of lack of upwelling given by the vertical sections. There is a north-south gradient of decreasing temperatures possibly due to the latitudinal increase in solar radiation toward the equator. The vertical distribution of oxygen shows the presence of a strong oxycline, particularly evident in the sections from south of Cape Cross (22 °S) to south Walvis Bay. The oxygen content varies from high levels of 5 - 6 ml/l in the upper 20 metres to almost anoxic conditions (0.3 ml/l) between 50 to 100 metres. Figures 6 and 7 show the oxygen concentrations near the bottom and at 100 m depth, respectively, and confirm the presence of a large body of almost anoxic water <0.2 ml/l O_2 over most of the shelf. The layer of anoxic bottom water was more than 30 m thick over most of the shelf in the central region.

3.2 Zooplankton distribution and abundance

The distribution and relative abundance of plankton over the survey area are shown in Figure 8. Stations where copepods and euphausiids formed the dominant group in the upper 50 m depth layer are shown in Figure 9. The distribution and abundance of the medusae, *Aequorea aequorea* and *Chrysoara hysosella* (numbers per 100 cubic metres) is shown in Figure 10.

Station data for Bongo net hauls and a general description of the plankton samples collected at each station are given in Annex I and II.

Zooplankton abundance

In the southern part of the research area, with the exception of an inshore station just north of Conception Bay (24°S), most of the coastal waters within 20 NM from shore had low plankton

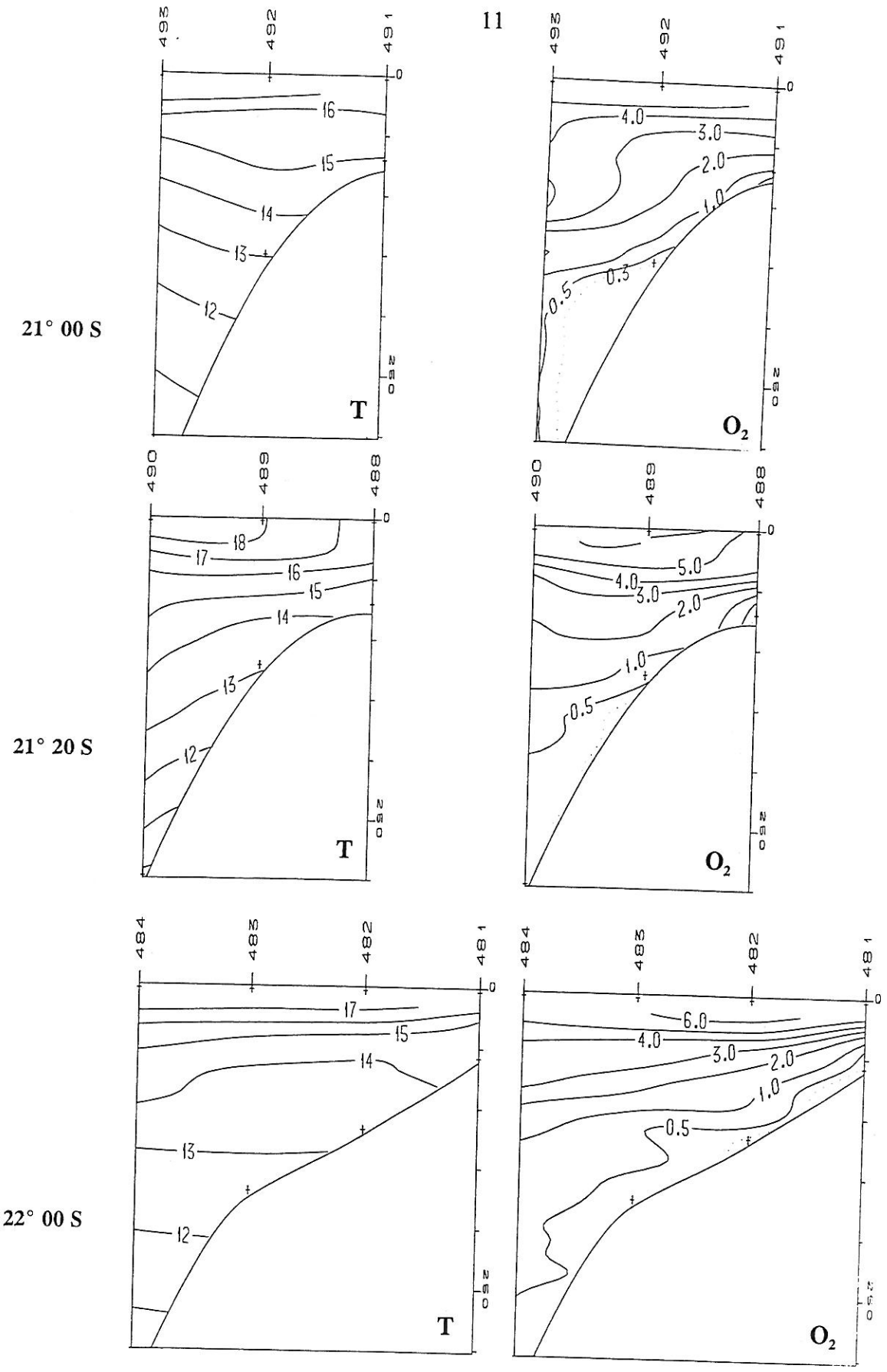
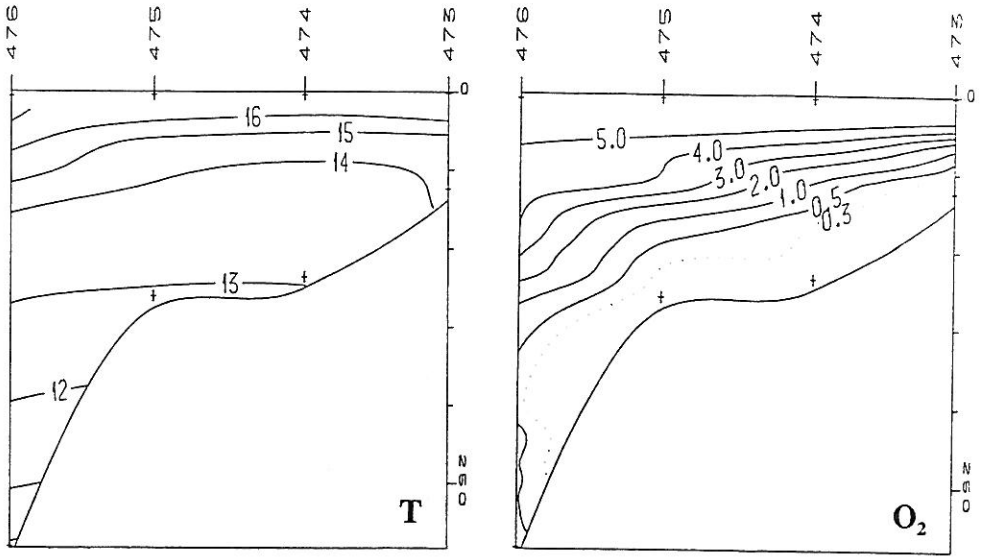
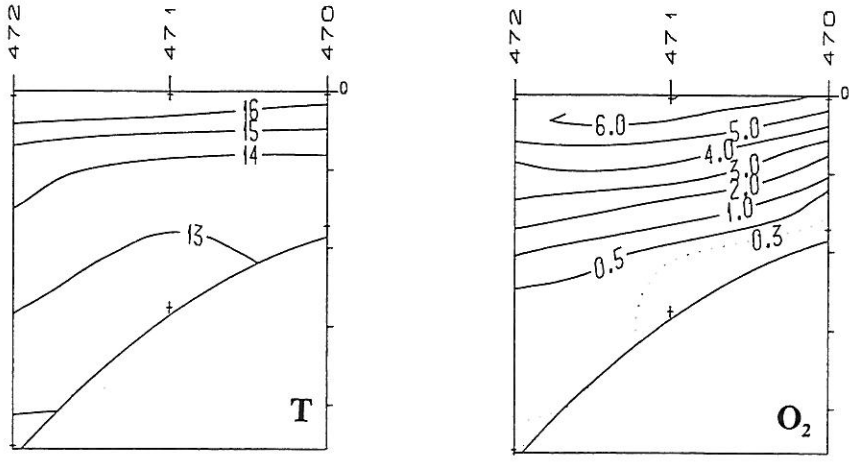


Figure 4. Vertical profiles of temperature (°C) and oxygen (ml/l) in the survey area. Depth in metres.

SWAKOPMUND
22° 40 S



WALVIS BAY
23°00 S



23°40 S

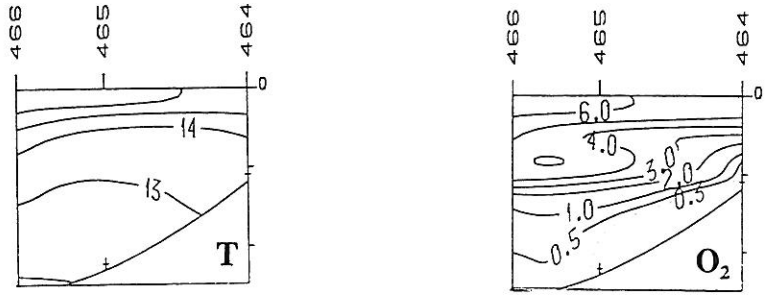


Figure 4. Cont.

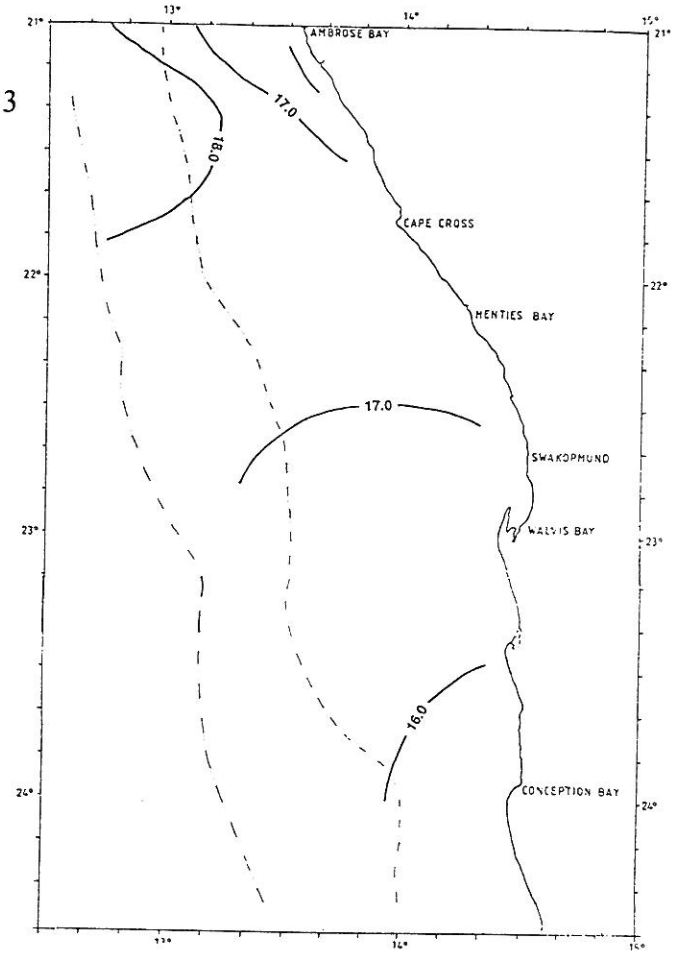


Figure 5. Water temperature at 5 m depth

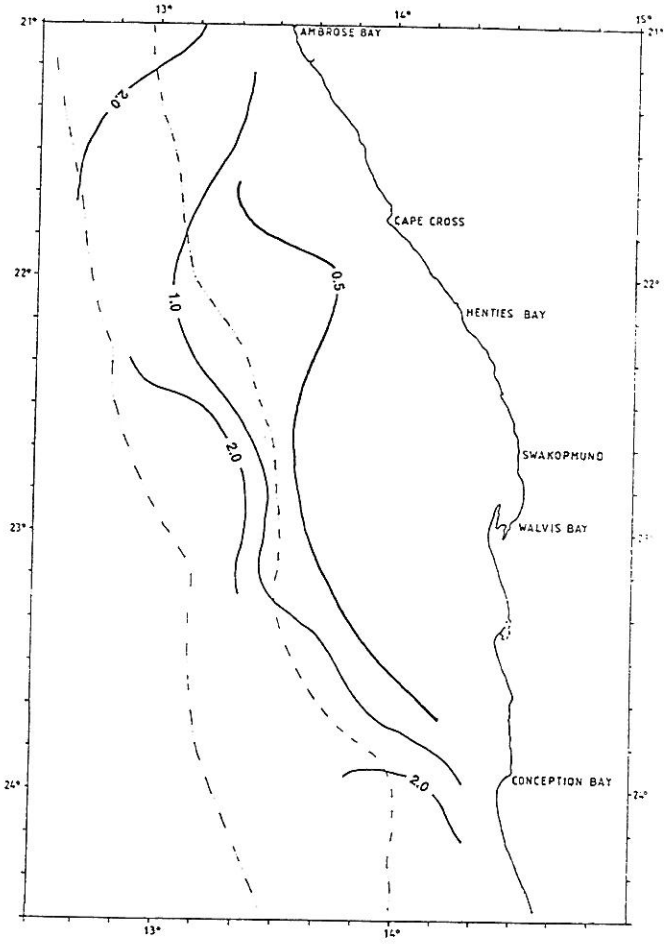


Figure 6. Oxygen concentrations (ml/l) at 100 m depth.

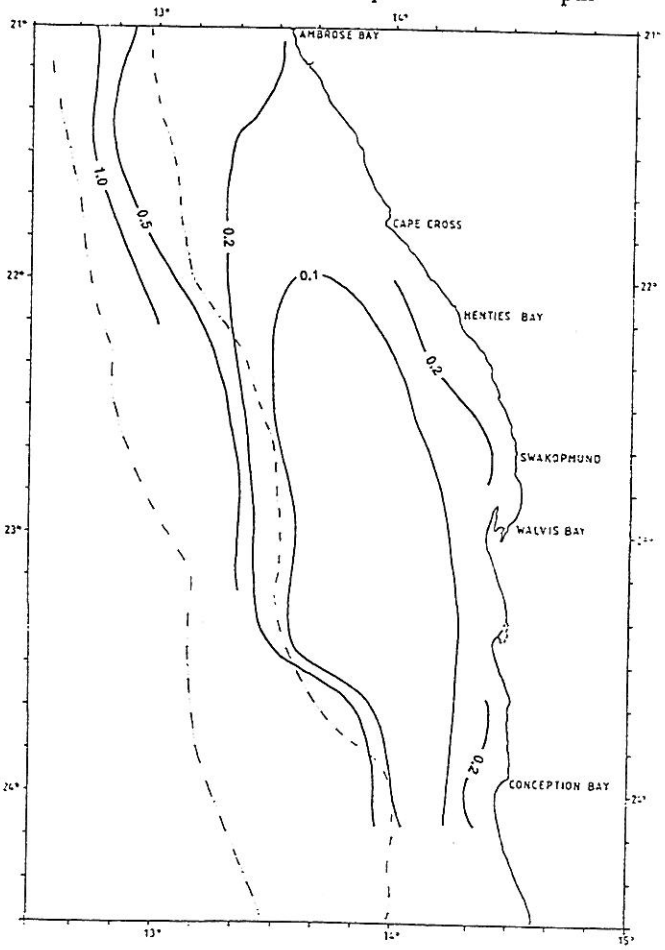


Figure 7. Oxygen concentrations (ml/l) near the bottom.

volumes. In contrast, higher volumes were recorded along the mid shelf region at distances of between 30 and 40 NM from the coast with the areas of greatest abundance being found west of Walvis Bay (23°S) where bottom depths ranged from 120 to 150 m. Zooplankton was also relatively abundant along the outer stations bordering the 200 m isobath.

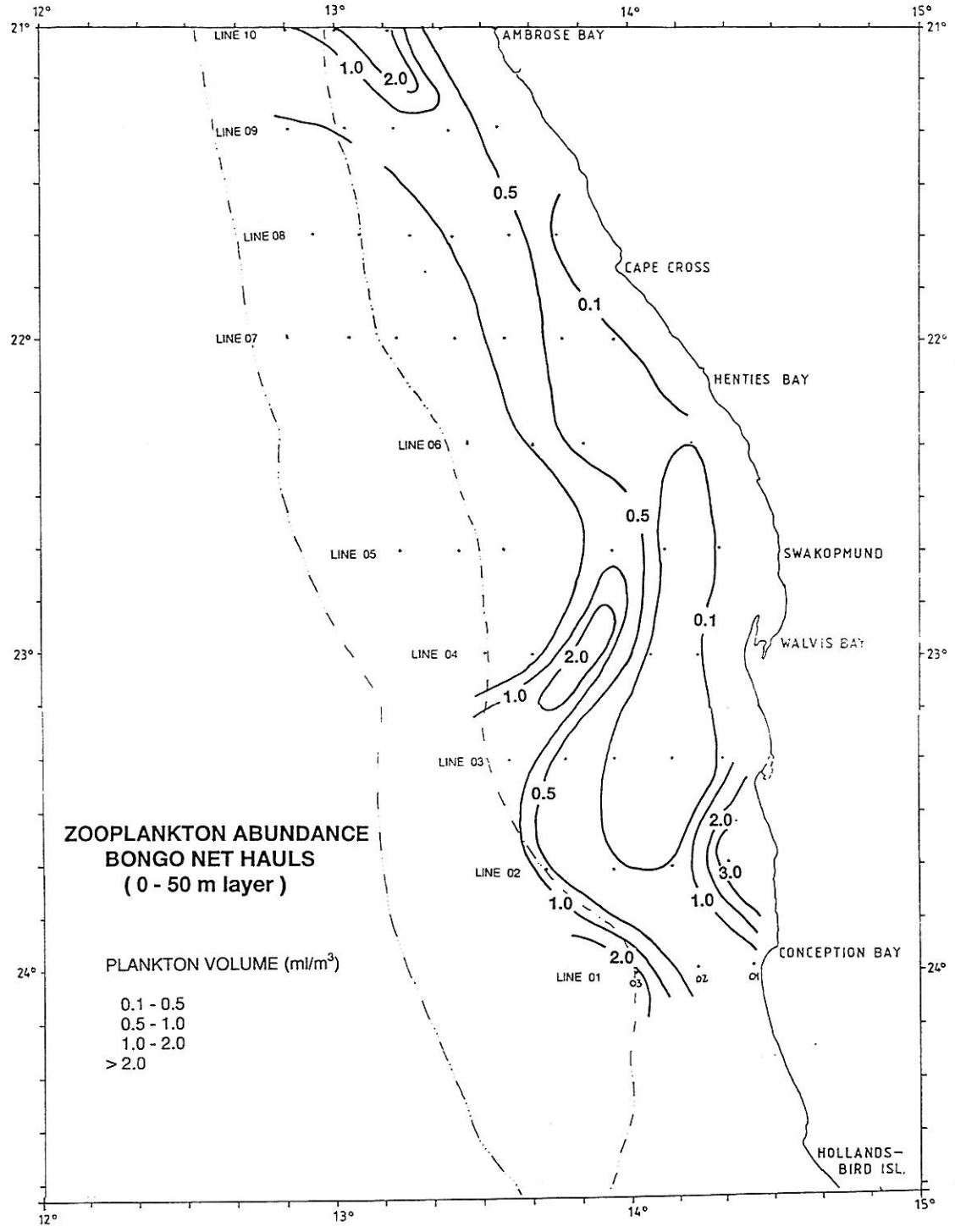


Figure 8. Distribution and relative abundance of plankton over the central Namibian shelf, 3-12 May 1996

In the northern part of the survey area, the pattern was generally similar with highest zooplankton volumes being recorded at distances of 20 to 30 NM from the coast. The area of greatest concentration of zooplankton was found along the most northerly line of stations to the west of Ambrose Bay (21 °S) and extended southwards along the mid shelf.

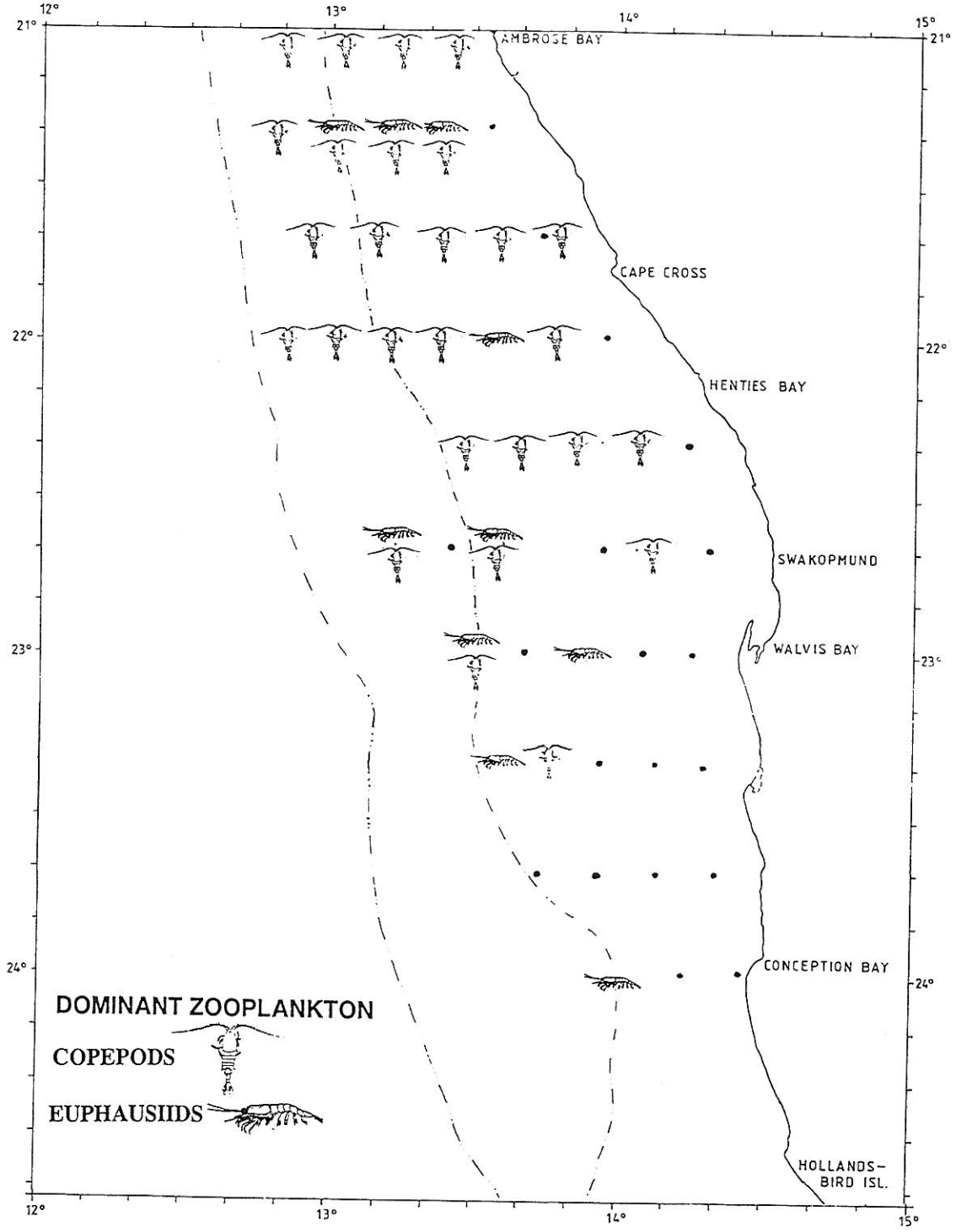


Figure 9. Stations where copepods and euphasiids were dominant in plankton samples

Composition of zooplankton

The plankton collected by the Bongo net consisted mainly of macroplanktonic organisms such as medusae and mesoplankton i.e. copepods, euphausiids and chaetognaths. Larval and juvenile fish were also captured in some tows.

Macroplankton

Medusae dominated the macrozooplankton throughout the region and comprised mainly two species, the magnifying jellyfish, *Aequorea aequorea* and the red jellyfish, *Chrysaora hysoscella.* There were also several stations where many small colourless medusae less than 2.0 cm in diameter were present.

Aequorea aequorea was found throughout the survey area from close inshore to over 60 NM offshore and was by far the most common jellyfish taken in the Bongo hauls. It's centre of maximum abundance was between 20 and 40 NM from the coast off Walvis Bay and between Cape Cross (21º50'S) and Henties Bay (22°10' S).

In contrast, *Chrysaora* sp. were found mainly in the inshore coastal waters between Walvis Bay (23°00'S) and Conception Bay (24°00'S). Greatest numbers were taken about 20 NM west of Conception Bay.

Mesoplankton

The dominant mesoplanktonic group taken in the Bongo nets were copepods such as *Centropages brachiatus* and *Calanoides carinatus*. These species often formed over 80 % of the plankton sample and were most common at stations in the northern half of the survey. Hauls in which copepods were most abundant were taken mainly over the central part of the shelf.

Euphausiids consisting mostly of *Nyctiphanes capensis* and to a lesser extent *Euphausia hansenii* were dominant at some stations in the southern part of the survey area and occurred in greatest numbers between 20 and 50NM offshore. There were also stations where both euphausiids and copepods were equally abundant in hauls. These areas were found to the west of Walvis Bay and south west of Ambrose Bay at distances of 30 to 60 NM from the coast.

Chaetognaths were also found to be relatively common in many hauls especially with copepods and were widely distributed throughout the survey region.

Other less common crustacean groups recorded in the plankton were cumaceans, amphipods and decapod larvae of various groups. The planktonic larval stages of a gastropod was very abundant in some of the samples taken between Cape Cross and Ambrose Bay.

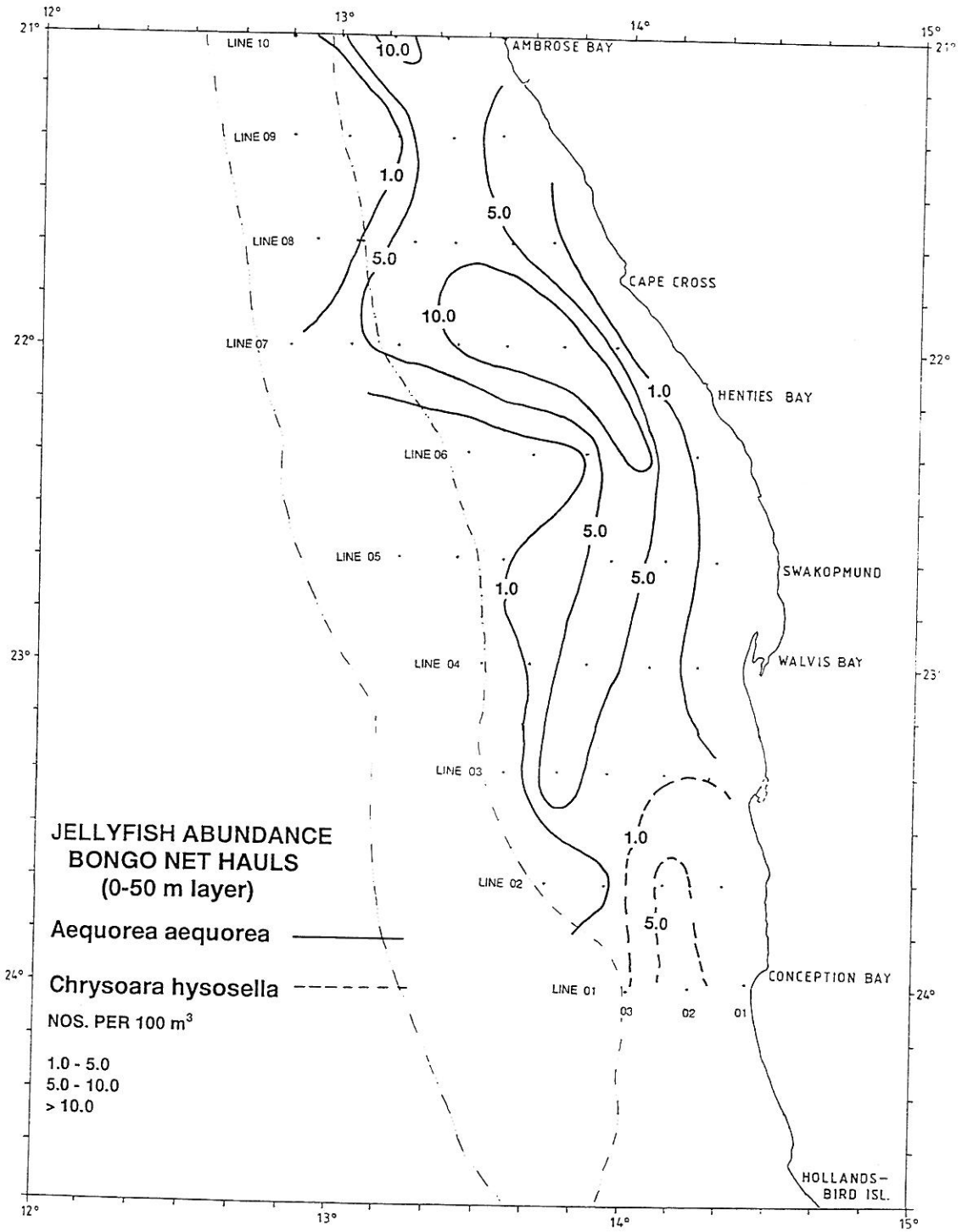


Figure 10. Distribution and relative abundance of two species of medusae, *Aequorea aequorea* and *Chrysoara hysosella* collected in Bongo nets over the central Namibian shelf, 3-12 May 1996

Fish larvae

Fish larvae were recorded in sixteen Bongo hauls or about 30 % of the total number of hauls. The species included horse mackerel, *Trachurus trachurus*, pelagic goby, *Sufflogobius bibarbatus*, hake, *Merluccius capensis* and anchovy, *Engraulis capensis*. The most common larva was that of the horse mackerel followed by the pelagic goby and hake.

The numbers and size ranges of most common fish larvae recorded over the survey area is shown in Table 1.

Table 1. The occurrence, number and size range of the most common fish larvae taken in the Bongo hauls

HORSE MACKEREL			GOBY			HAKE		
Station	Nos.	Range (mm)	Station	Nos.	Range (mm)	Station	Nos.	Range (mm)
02-02	2	32.0-35.0	03-05	1	30.0	03-05	2	10.2-12.3
06-03	2	6.5-9.8	04-03	1	10.5	04-03	3	10.2-12.3
06-05	1	5.2	07-02	1	45.0			
07-05	6	5.2-8.0	07-03	2	45.0-60.0			
07-06	6	6.0-8.0	07-04	1	20.0			
07-07	1	8.0						
08-04	3	5.0-15.0						

Phytoplankton

The nets used on the survey were not intended to collect phytoplankton samples and had a relatively coarse mesh size of 500 microns. However, high concentrations of phytoplankton were taken at two inshore stations off Cape Cross. These samples consisted of thick filaments of *Fragilaria* sp. a chain forming diatom that occurs frequently in inshore waters of the Namibian coast.

Diurnal variation in catches

Of the total number of stations sampled, 55 % were taken during daylight hours and 45 % at night-time. There was little difference between the mean volumes of plankton collected over the diurnal cycle with 45.5 ml/m^3 being recorded during daylight hours and 49.0 ml/m^3 for night hauls.

3.3 Distribution of the main species as observed with the echo-integration system

Figure 11 shows the distribution of the total S_A values from the echo-integration system. The highest total values were found on the shelf region south of Walvis Bay, and along the shelf edge, consisting mainly of gobies (*Sufflogobius bibarbatus*) mixed with juvenile horse mackerel and juvenile hake in thick scattering zooplankton layers. The high values close to the coast consisted mainly of horse mackerel and some round herring. There is a region in the middle of the shelf with extremely low total S_A values. This region probably has the most difficult living conditions of the whole shelf area, possibly because of the limited water mass dynamics here. Shallower coastal waters in fact are subject to vertical mixing due to local winds while in the deeper part of the shelf although the oxygen values are very low, a rich pelagic community is found in the overlaying water masses. Figure 12 shows the distribution of S_A values in the bottom channel (about 10 m from the bottom). The large area with mostly 0-values largely coincides with the area delimited by the 1 ml/l oxycline at the bottom (see Fig. 5).

3.4 Distribution of juvenile hake from acoustic and bottom trawl survey

Figure 13 shows the distribution of juvenile hake as obtained from the echo-integration system. The scrutinising process was extremely difficult because juvenile hake were mostly mixed with the pelagic community during night-time and with larger juvenile hake near the bottom during daytime. Sampling with pelagic and bottom trawl was often disrupted by the presence of jellyfish and the relative proportions found in the catches may not be representative. Therefore, the values presented are only meant to provide a general idea of its distribution but they are not considered reliable enough for abundance estimation.

Zero-group hake was mostly found on the outer part of the shelf, usually mixed with older fish. It was not found in the inner part of the shelf. Highest catches were obtained at about 150 m depth. A preliminary examination of a few stomachs showed the presence of euphausiids, juvenile gobies and other juvenile fishes. The lowest mode of the length frequency distributions is about 15 cm, probably fish hatched in spring (August/September) 1995. Although caught in a few pelagic trawls, this group was mainly close to the bottom. This indicates that the 0-group has already entered the demersal mode of life. Highest bottom trawl catches were obtained on the outer part of the shelf between Ambrose Bay and Cape Cross.

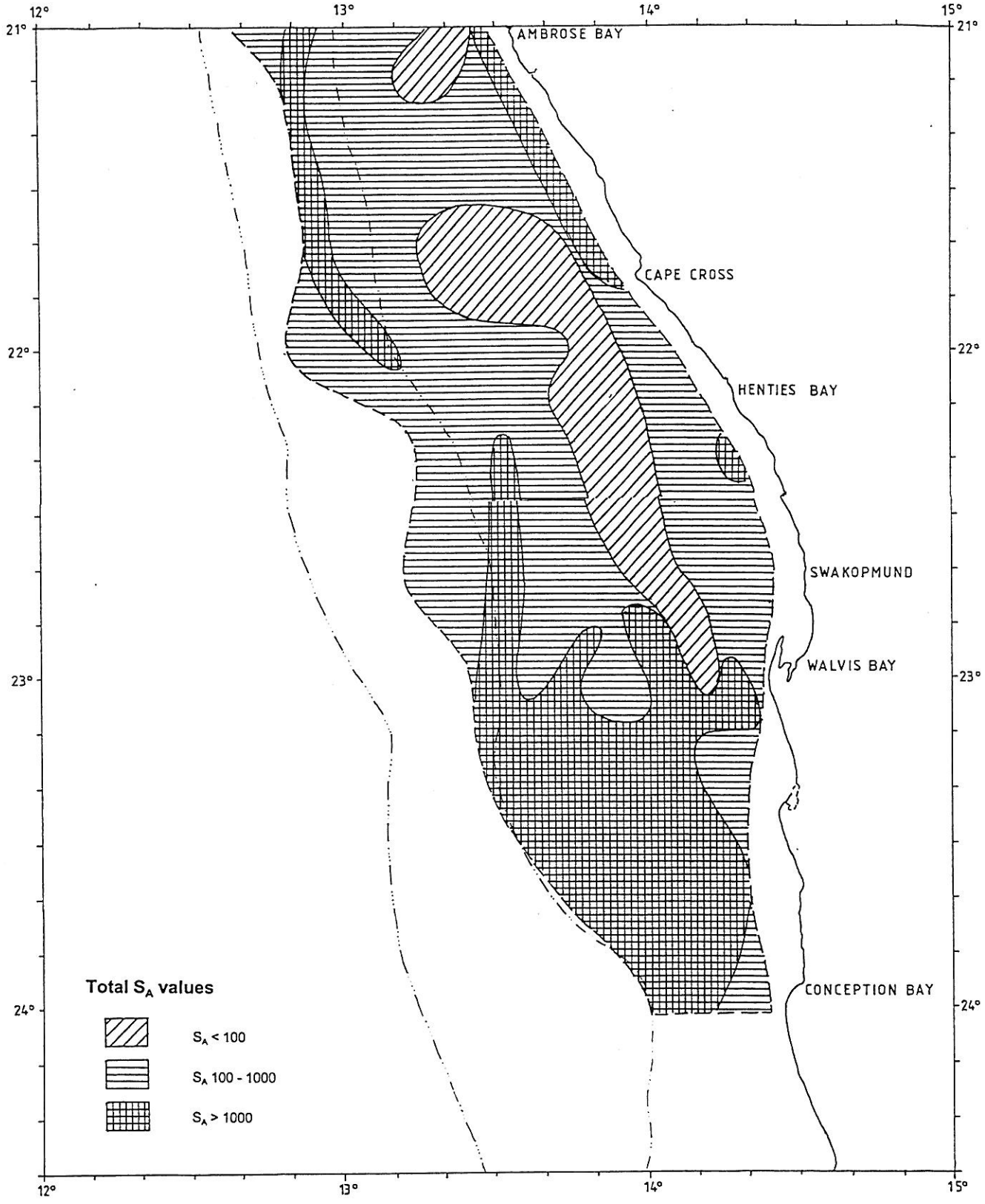


Figure 11. Distribution of total S_A values from the echo-integration system.

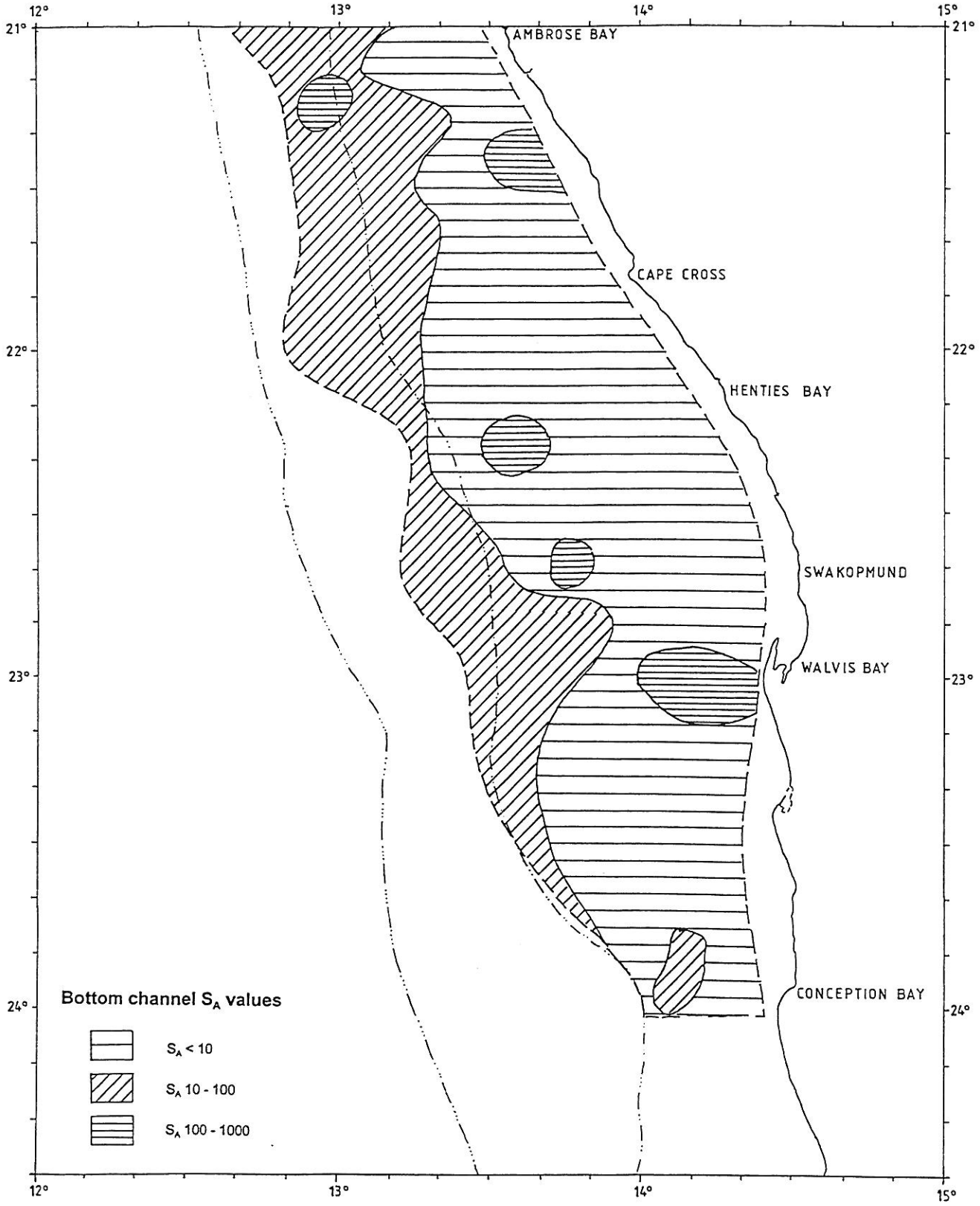


Figure 12. Distribution of S_A values in the bottom channel (from the bottom to 10 m above).

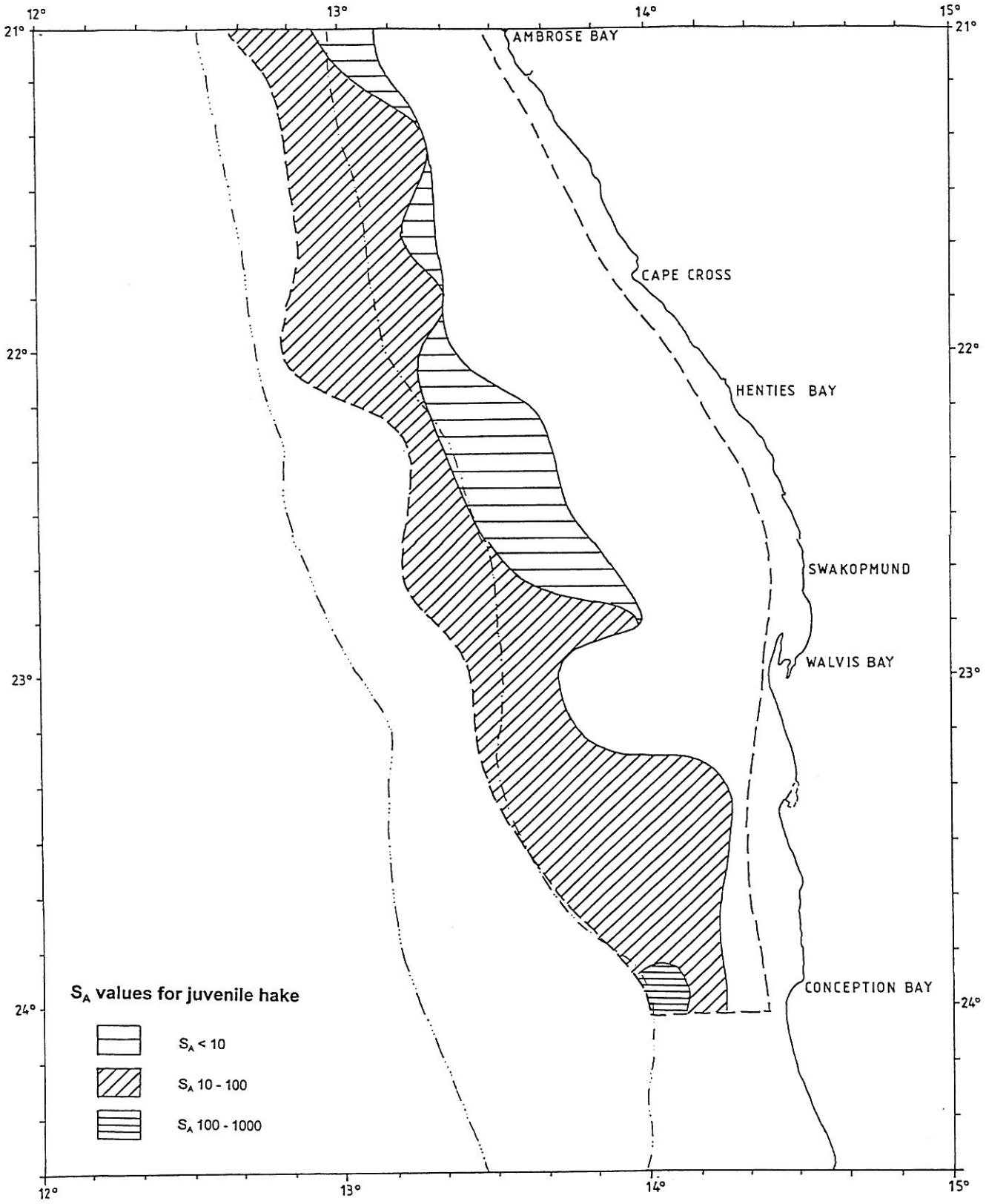


Figure 13. Total distribution of juvenile hake.

3.5 Seal distribution and abundance

More than 200 sighting distances were measured and the frequency distribution of these will be used to calculate the area covered by the counts and the density index. The preliminary frequency distribution of some of these measurements is given in Fig. 14 (not all of the collected data has been analysed at this point in time).

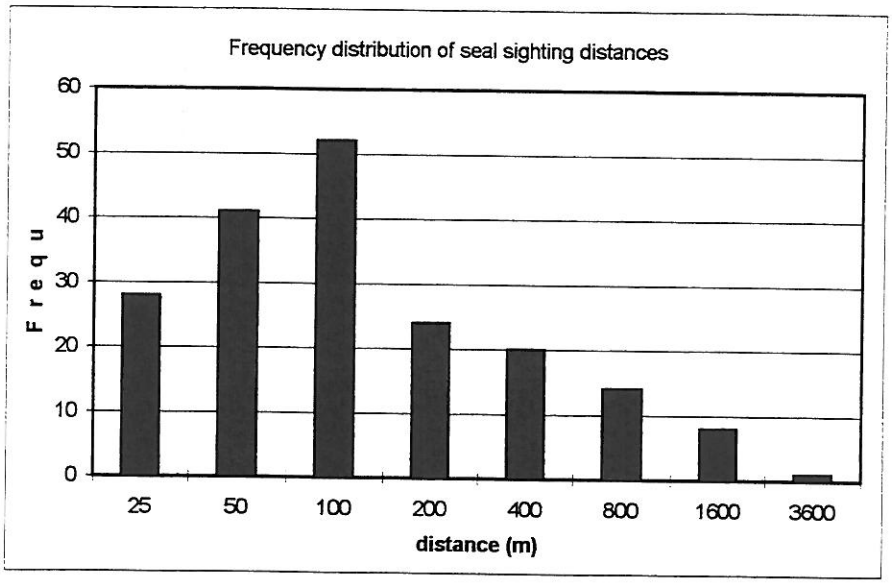


Figure 14. Preliminary frequency distribution of the seal sighting distances.

A total of 203 "*10 min counts*" were performed throughout the area as well as 40 observation periods during trawling stations and 18 observation periods during other sampling stations (CTD and Bongo stations).

The bulk of the data collected has not been analysed and the following constitutes more a general impression than actual results. Seals were present throughout the area at fairly low density, becoming rare near the shelf edge (Fig. 15). This impression was confirmed by the fact that very few seals attended trawling operations. No seals were seen during 113 counts, and only 23 *"10 min count"* comprised 4 seals or more. The largest groups of seals were observed close inshore (particularly near the Cape Cross colony).

Two seals were incidentally caught in trawls. Post-mortem examinations were conducted and stomach contents collected for later identification of prey consumed.

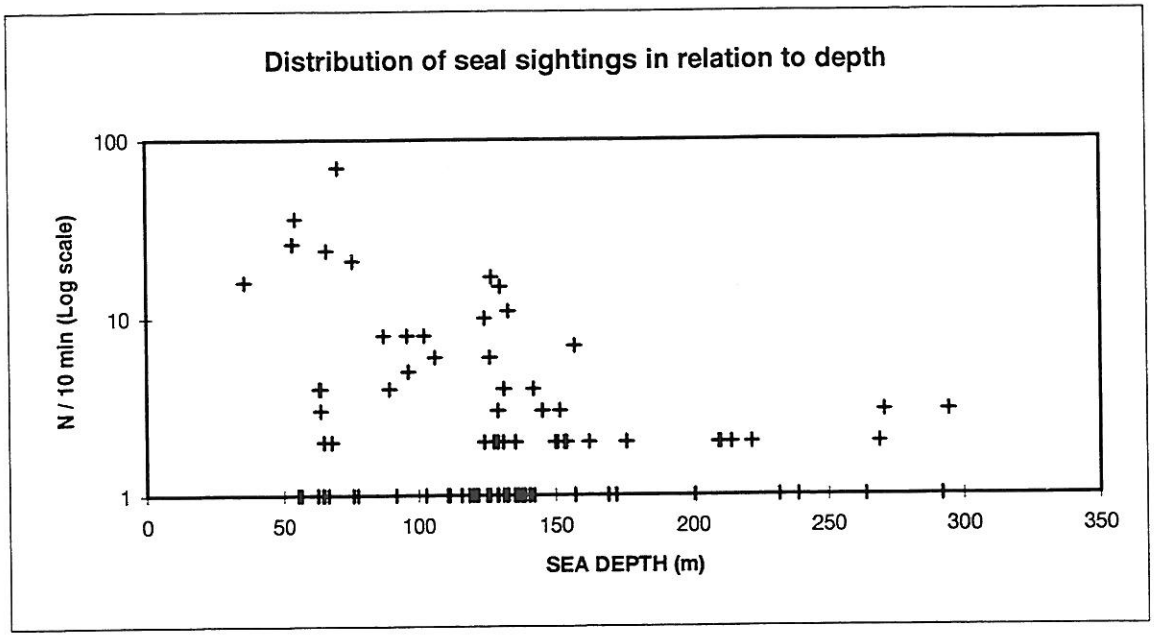


Figure 15. Seal distribution in relation with bathymetry during the 10 min. counts.

Other marine mammals

Dusky dolphins, *Lagenorhynchus obscurus*, were sighted 5 times on the inner shelf between 60 and 130 isobaths. Notes were made on behaviour, group size etc. One dolphin was incidentally caught in a trawl and a post-mortem was effected. Stomach contents were collected for later identification of prey consumed.

3.6 Bird distribution and abundance

About 200 *"10 min counts"* were performed throughout the area and seabird observations were made during 40 trawling operations and 15 other stations. In addition, 8 incidental observations were made out of the *"10 min"* or *"station"* counts.

Only 17 species were encountered during this cruise. The species list is given in Table 2.

Table 2. Seabird species identified during the survey given with the total number of individuals sighted (all observations combined). Most of the unidentified terns were common terns, some of them might have been arctic terns.

Common names	**Scientific names**	**Total number sighted**
Jackass penguin	*Spheniscus demersus*	2
Black-browed albatross	*Diomedea melanophris*	153
Yellow-nosed albatross	*Diomedea chlororhynchos*	145
Shy albatross	*Diomedea cauta*	22
White-chinned petrel	*Procellaria aequinoctialis*	2866
Cory's shearwater	*Calonectris diomedea*	1
Great shearwater	*Puffinus gravis*	1
Sooty shearwater	*Puffinus griseus*	78
Manx shearwater	*Puffinus puffinus*	1
Wilson's storm petrel	*Oceanites oceanicus*	757
Cape gannet	*Sula capensis*	566
Cape cormorant	*Phalacrocorax capensis*	119
Subantarctic skua	*Catharacta antarctica*	36
Kelp gull	*Larus dominicanus*	15
Sabine's gull	*Larus sabini*	14
Arctic tern	*Sterna paradisaea*	11
Common tern	*Sterna hirundo*	116
Unidentified terns	*Sterna* sp.	133

The data on the distribution and abundance of the different species has not yet been analysed in detail but already some patterns have emerged. The coastal area (inside the 75 m isobath) had few species, mainly local breeding birds (kelp gulls, Cape cormorant and juvenile gannets being the most characteristic). The inner shelf had generally a low density of sea birds, gannets (juveniles and adults being the most common). Beyond the 130 m isobath the seabird community showed a striking change with the yellow-nosed albatross, the black-browed albatross and the subantarctic skua as the most characteristic birds. Two of the common species (Wilson's storm petrel and white chinned petrel, although also found over the inner shelf, became much more abundant in that zone. Finally, in deeper waters (beyond the 250 m isobath) the shy albatross appears in the records. Some of these patterns are illustrated in Figs. 16 and 17.

Virtually all records of albatrosses and skuas were made beyond the 130 m isobath. This limit also seems to correspond to peaks in abundance of other species like the Wilson's storm petrel and the white-chinned petrel (Fig. 17). This limit was so striking that it has been named the "Albatross line" during the cruise and is illustrated in the map of Fig. 18. Such a discontinuity in the distribution of seabirds suggests the presence of a front or fronts running

along the 130 m isobath. Although the hydrology of the area has not been studied at a scale suitable to detect these types of features, the thermograph records seem to confirm the presence of several distinct water masses in the area some of them featuring sharp fronts along the 120-150 isobaths as illustrated in Fig. 19.

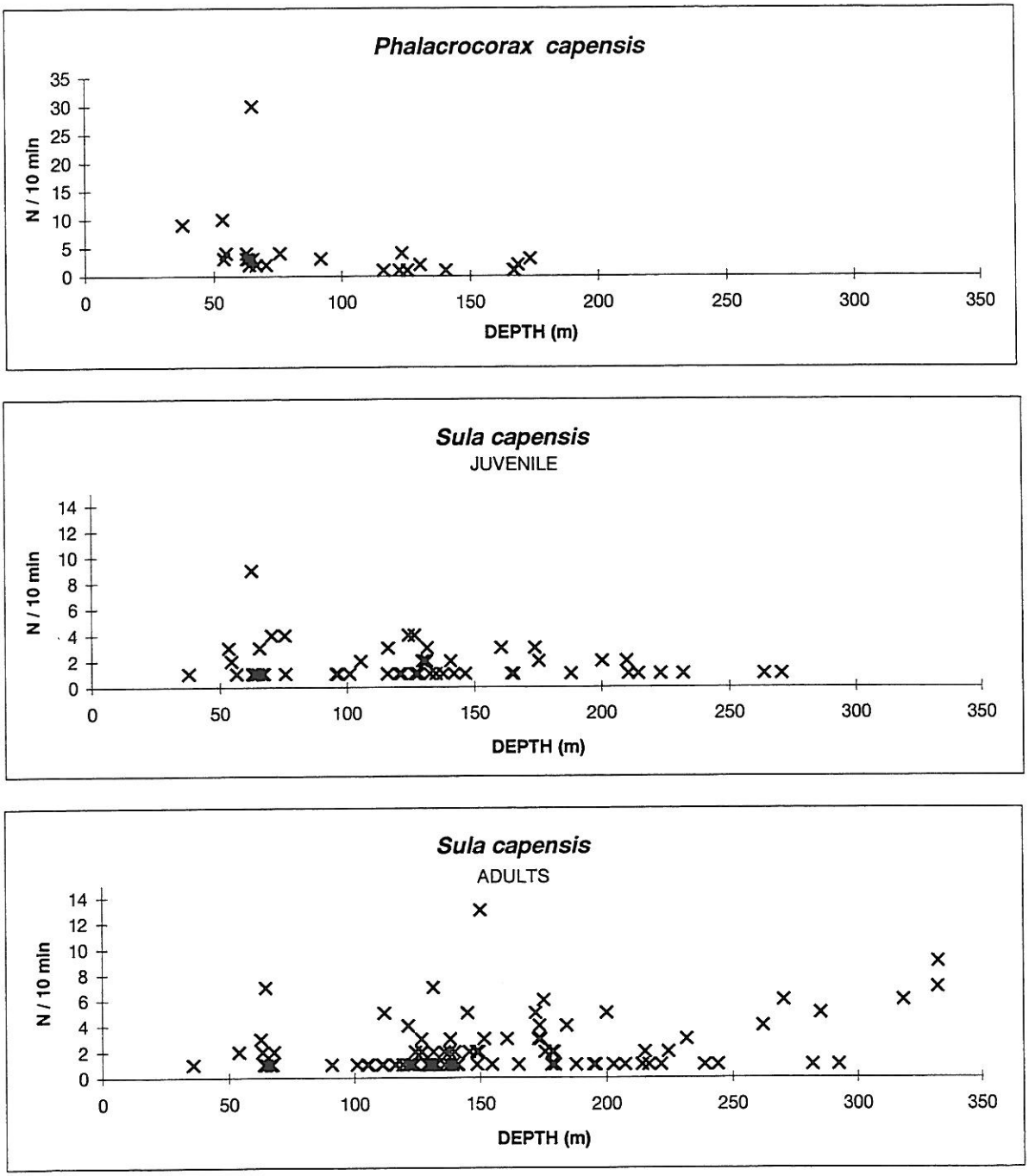


Figure 16. Distribution in relation to bathymetry of some seabird species characteristic of the coastal zone (Cape cormorant, top), coastal zone and inner shelf (juvenile Cape gannet, middle), and the whole shelf (adult Cape gannet, bottom).

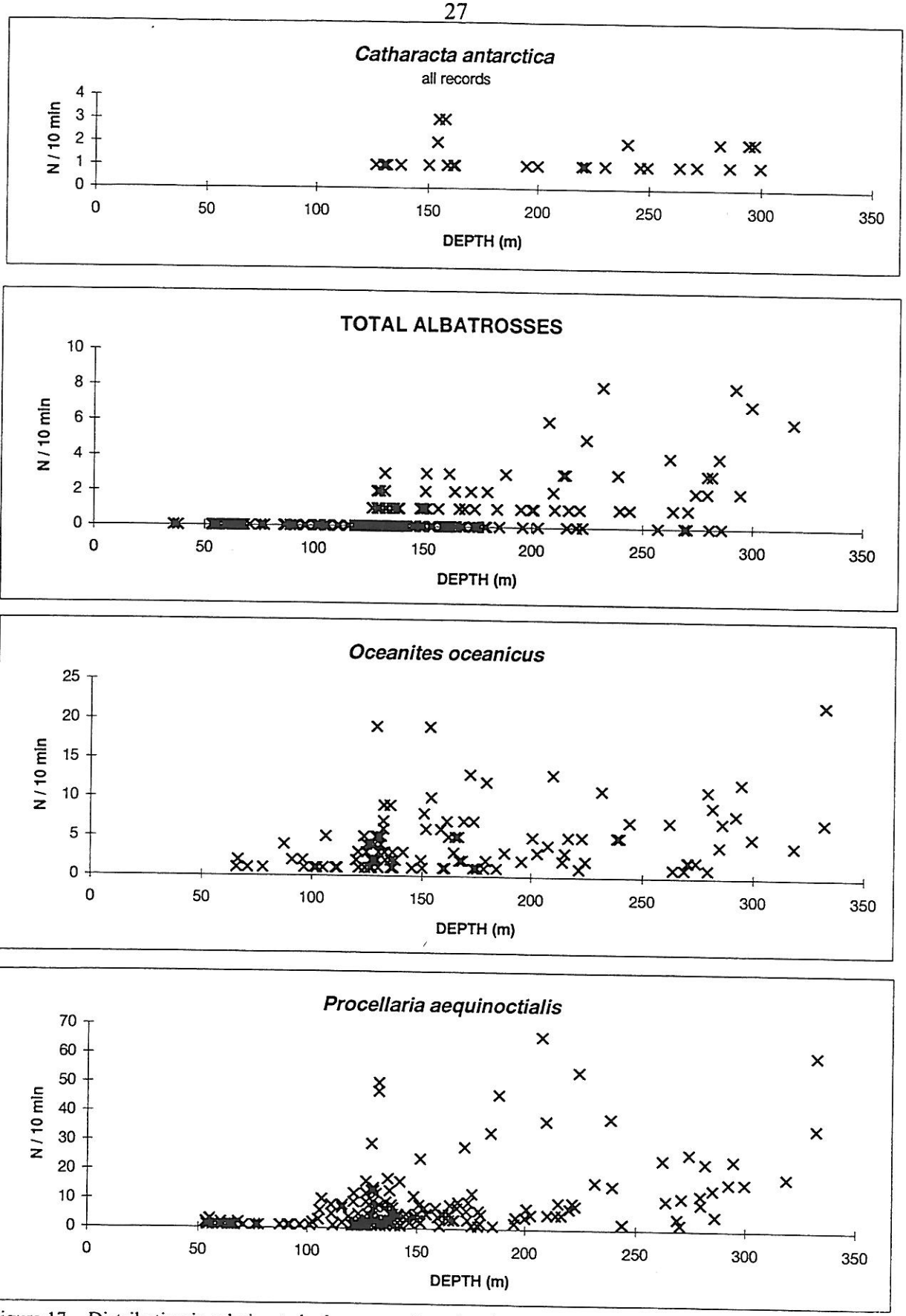


Figure 17. Distribution in relation to bathymetry of species characteristic of the outer shelf, all showing some kind of discontinuity around the 130m isobath, the *"Albatross line"*.

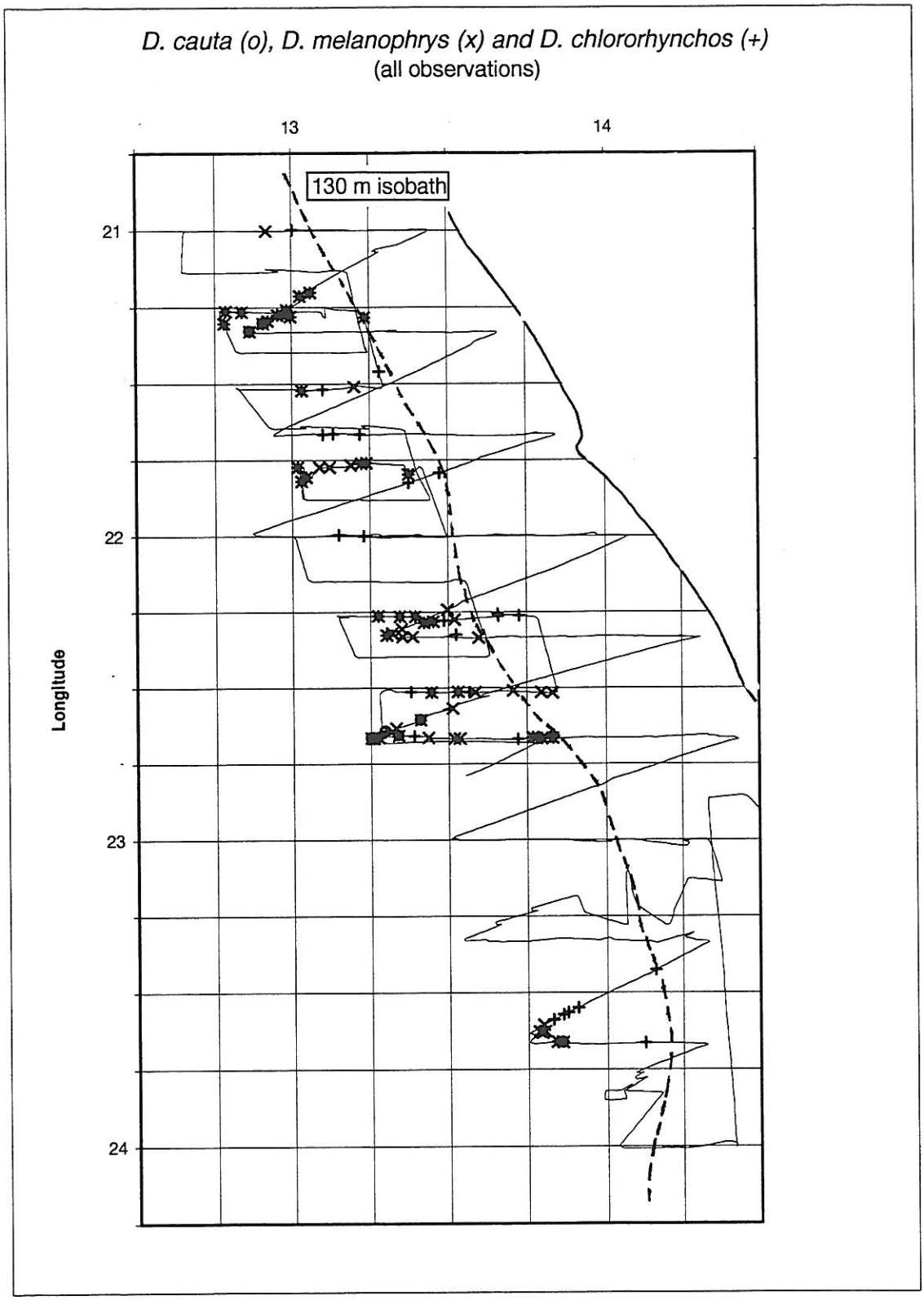


Figure 18. Map of all albatrosses sightings during the cruise in relation to the 130 m isobath.

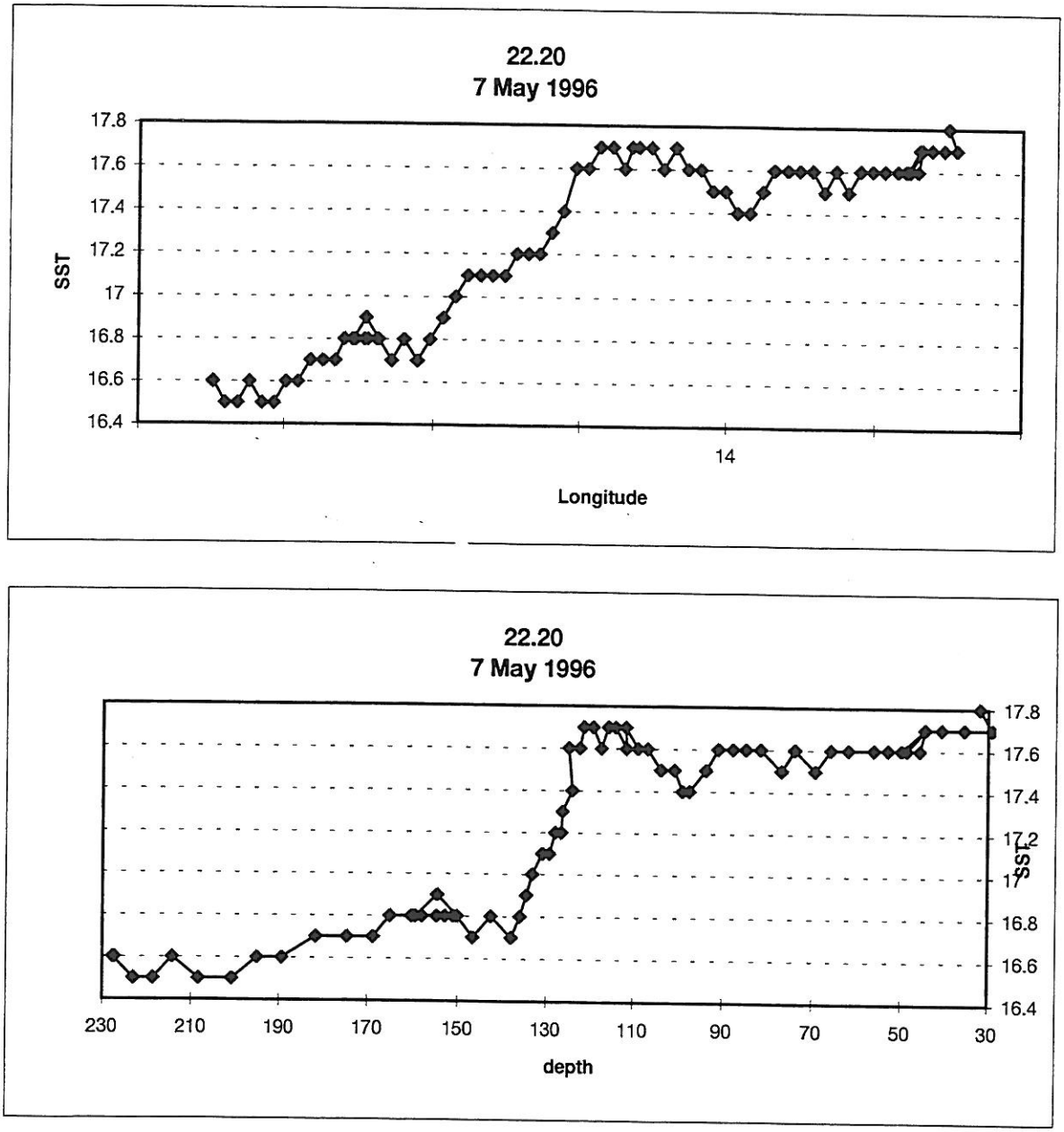


Figure 19. Surface temperature recordings from the ship's thermograph along the 22° 20'S transect.

3.7 Ecophysiology

Cape hake spend much of their first year living pelagically, feeding on zooplankton organisms in the upper waters off the Namibian coast (Nansen Report: October, 1995). At the end of this pelagic phase, juvenile hake settle to the seabed on the shelf, to begin their

demersal phase of life as predatory ground fishes and grow into adults. During their pelagic feeding phase, the principal concentrations of post-larval hake have typically been located over the middle of the coastal shelf. As they change their habit to become demersal, the 0-group fish leave the water column, beginning to settle on mid-shelf grounds. The initial settlement areas for 0-group hake often appear to lie close to the broad azoic zone of green mud and oxygen-deficient bottom waters in which toxins may abound. Such anoxic conditions may make areas of shelf seabed unsuitable for habitation by juvenile hake when they seek bottom habitat on completion of their planktonic phase of life. The extent of this anoxic zone may significantly reduce the area of shelf habitat that is suitable for 0-group settlement and survival.

In the surveys few 0-group hake were caught on the shelf in waters less than about 130 m.

There are significant constraints for active predation in hypoxic environments. Large aerobic costs are incurred during the active pursuit, and the digestion of prey. Recovery from these oxygen debts will be delayed in oxygen-depleted environments. In conditions of hypoxia, Cape hake appear to be able to utilise the high oxygen concentrations (89% O_2) which occur in their swimbladder gas. Hake feeding and digesting a meal have been shown to draw down their swimbladder oxygen, probably to supplement respiratory oxygen supplies required to meet the high metabolic demands of digestion (see Part I, this report). Investigations of these capabilities are being continued. Swimbladder gas of 0-group (11-14 cm) and I-group Cape hake (15-20 cm), had about the same oxygen content as had previously been measured for adult hake 50-80 cm long. The juvenile hake had an average oxygen-content of 89%; there was no change in swimbladder gas composition with size in Cape hake.

Analyses were also made of swimbladder gas samples taken from other species. The average oxygen content for gas from deepwater hake, *M. paradoxus*, had somewhat lower oxygen content than Cape hake, 88% versus 89%. Comparing gas contents of the two species of hake caught in the same trawl samples, the small difference in oxygen between species appeared to be consistent, and significant. Other analyses were made on toadfish, *Chatrabus melanurus*, a species which appears to be relatively tolerant of hypoxia. Toadfish had a mean oxygen content of 90.6% O_2 in their swimbladders.

Collections of blood were made from freshly caught Cape hake. Blood was taken directly from the heart by cardiac puncture. Whole blood samples were taken from a series of individual hake, labelled and stored frozen. The blood will be used for studies of the

respiratory capabilities of hake in relation to their tolerance of severe environmental hypoxia. The blood-haemoglobin affinity for oxygen will be assessed by determination of the haemoglobin-oxygen dissociation characteristics, and estimation made of the oxygen-carrying capacity of hake blood.

CHAPTER 4 CONSIDERATIONS ON THE SURVEY RESULTS

4.1 General ecological conditions on the central Namibian shelf

The inner grounds of the central Namibian shelf are widely covered by fine 'green muds'. These generally extend from near the coast out across the shelf to about 100 m. The green mud is formed from sedimented excess phytoplankton produced in rich blooms at the sea surface, which die back and sink to the bottom. The muds have very high organic contents of more than 12% carbon. Biochemical degradation of the heavy loadings of organics in the lower water column and in the muds, uses oxygen, which is stripped from the seawater. These large-scale processes of organic breakdown cause persistent oxygen-depletion in waters near the seabed, which sometimes become anoxic over wide areas of the shelf. The organic-rich green muds produce anaerobic compounds which are released into the overlying waters. Some anaerobic products are toxic to fishes. They interfere with its ability to take up oxygen and reduce the oxygen-carrying capacity of the blood. Bottom fishes may be expected to avoid, or be excluded from, shelf areas covered by such oxygen-deficient and toxic conditions. Upwelling during the winter season is probably one of the main mechanisms to reduce the extent of the oxygen depleted waters and possibly restricting the anoxic regions. Year to year variability in upwelling intensity may greatly affect the conditions in this area, which in turn will affect the development of the early life stages of hake, particularly in the transition phase from pelagic to demersal.

The distribution of plankton and vertebrates, including birds, shows the presence of an almost abiotic shelf zone whose offshore outer boundary is located roughly at 130 m depth. This boundary was named '*the albatross line*' as coincided with the inner margin of the albatross distribution. Very little is however known on the dynamics in this region, and how permanent these features are on a seasonal and annual basis.

4.2 Comments on the sampling methods

The present survey failed to detect large concentrations of 0-group hake. Four possible factors may have contributed to the non-availability of the 0-group:

(a) recruitment failure of the 1995 year-class
(b) change in the distribution area of the nursery grounds
(c) change to the demersal phase with consequent spreading of juveniles over a larger area
(d) failure of the sampling methods and survey design utilised

During the October egg and larval survey (Anon. 1995), the number of spawners found in the central area was relatively low and the temperature was cooler than normal. Such cold temperatures may inhibit growth during the critical period of egg and larval development.

The hypoxic- anoxic conditions that prevailed in the central area during most of 1994/95 may have caused the spawners to spawn elsewhere or to negatively affect spawning altogether.

Length frequency distributions have shown that the mode of juvenile hake caught was about was about 15 cm. This may indicate that it is probably too late to find large concentrations of 0-group in its pelagic phase.

Drawbacks of the methods utilised are several. The acoustic integration system does not seem to be suitable to develop an index of abundance of 0-group hake, under the conditions encountered during the present survey. The areas where juvenile hake were caught by pelagic trawl were characterised by one or more scattering layers consisting of plankton, gobies, other juvenile fish etc. which made the scrutinising process extremely difficult and finally not reliable. Although much sampling was performed, the representativeness of the catches is rather poor because of the presence of large quantities of jellyfish and for the uncertainty regarding which level of the water column the species caught came from. These conditions also made impossible the task of target strength measurements. Bottom trawl sampling during daytime might be a better measure of juvenile abundance at about 1 year of age, but would require a latitudinal extension of the survey area. Also in this case, however the type of trawl used might not be suitable. The smaller hake may in fact pass through the large meshes of the wings affecting the reliability of the catch data.

4.3 Conclusions and recommendations for future work

The main objective of this survey was to determine the abundance of 0-group hake with the echo-integration system and study the ecological conditions in the survey area. Large concentrations of 0-group hake were not found and the main objectives of the survey could

not be fulfilled. However, the survey resulted in a multidisciplinary effort to understand the ecological conditions in the central Namibian shelf. This effort is considered worthwhile, given the dramatic conditions found in this region and its critical role in the early life stages of important commercial species. Based on the above experience, the following is recommended:

1) The identification of the echo-traces in the water column could be made more reliable by the utilisation of a pelagic trawl equipped with opening/closing mechanisms that would allow sampling at the desired sampling depth. This also applies the Bongo net for plankton sampling.

2) Jellyfish represent a major hindrance in the sampling process with trawl gear. Efforts should be made to device equipment able to filter the jellyfish, without affecting the fish composition in the catches.

3) Should a new attempt be made to identify large concentrations of juvenile hake, this should take place in January/February, when the probability of encountering 0-group are highest.

4) The data collected during the present survey should be analysed more thoroughly. A suitable statistical tool should be identified, able to integrate the different sources of information in a three-dimensional environment (possibly a GIS system).

5) Based on the results obtained from a deeper analysis of the data, it might be desirable to extend the study to cover different seasons to understand the seasonal dynamics of the region, and possibly construct a time series that would allow to evaluate the year to year fluctuations and their impact on the main resources.

The results of the trawl measurements on the R.V. 'Welwitchia' are presented in Annex V.

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Sundby, S., O'Toole M. (1995). Investigation on spawning hake and their eggs and larvae (27 September-7 October1995). Cruise reports Dr' Fridtjof Nansen'.

Wysokinski (1983). Photographic guide for determining age of hake from otoliths. S.Afr.J.mar.Sci. 1:19-55

Annex I Station data for Bongo net hauls.

Date	Grid	Sounding (m)	Max.Depth (m)	Time	Vol/Filtered (cubic metres)	Vol/Plankton (ml)
3.5.96	01-01	55	45	19:00	94.35	18.0
3.5.96	01-02	118	50	20:19	67.32	12.0
3.5.96	01-03	189	50	21:46	100.98	260.0
4.5.96	02-01	89	50	06:04	100.98	28.0
4.5.96	02-02	147	50	07:08	117.80	10.0
4.5.96	02-03	176	50	08:28	100.98	14.0
4.5.96	02-04	190	50	10:26	134.64	28.0
4.5.96	03-01	80	50	18:40	100.98	15.0
4.5.96	03-02	121	50	20:53	117.85	12.0
4.5.96	03-03	157	50	22:43	100.98	7.0
4.5.96	03-04	164	50	23:50	100.98	17.0
5.5.96	03-05	190	50	00:08	117.85	190.0
5.5.96	04-01	93	50	13:54	100.98	15.0
5.5.96	04-02	128	50	16:02	87.79	14.0
5.5.96	04-03	147	50	18:09	90.88	250.0
5.5.96	04-04	180	50	19:24	96.77	24.0
5.5.96	04-05	230	50	21:43	100.41	24.0
6.5.96	05-01	67	50	05:34	104.34	5.0
6.5.96	05-02	103	50	06:42	110.79	12.0
6.5.96	05-03	112	50	08:09	107.99	32.0
6.5.96	05-04	130	50	09:21	103.50	57.0
6.5.96	05-05	139	50	12:13	121.17	16.0
6.5.96	05-06	255	50	13:14	168.30	11.0
6.5.96	05-07	300	50	14:49	201.96	11.0
7.5.96	06-01	55	50	00:58	100.98	10.0
7.5.96	06-02	111	50	04:30	84.15	20.0
7.5.96	06-03	130	50	06:17	84.15	18.0
7.5.96	06-04	165	50	09:00	87.51	35.0
7.5.96	06-05	229	50	10:07	100.98	30.0
7.6.96	07-01	65	50	16:58	151.47	275.0
7.5.96	07-02	100	50	18.15	134.64	23.0
7.5.96	07-03	123	50	20:05	117.81	108.0
7.5.96	07-04	164	50	21:15	252.45	10.0
7.5.96	07-05	175	50	22:44	117.81	40.0
8.5.96	07-06	275	50	01:55	134.64	25.0
8.5.96	07-07	344	50	03:26	84.15	45.0
8.5.96	08-01	80	50	11:10	100.98	8.0
8.5.96	08-02	102	50	12:09	134.64	50.0
8.5.96	08-03	131	50	13:18	117.81	23.0
8.5.96	08-04	154	50	14:24	100.98	20.0
8.5.96	08-05 A	220	50	17:04	117.81	25.0
8.5.96	08-05 B	220	50	17:15	420.75	55.0

Annex I. (Continued)

Date	Grid	Sounding (m)	Max.Depth (m)	Time	Vol/Filtered (cubic metres)	Vol/Plankton (ml)
9.5.96	09-01	81	50	00:45	84.15	23.0
9.5.96	09-02	112	50	01:53	100.98	80.0
9.5.96	09-03	133	50	04:05	134.64	75.0
9.5.96	09-04	200	50	05:10	151.47	75.0
9.5.96	09-05	309	50	06:33	84.15	15.0
9.5.96	10-01	81	50	13:22	134.64	35.0
9.5.96	10-02	120	50	14:30	100.98	130.0
9.5.96	10-03	167	50	16:44	100.98	35.0
9.5.96	10-04	291	50	17:43	103.50	22.0
9.5.96	10-05	356	50	19:20	117.81	35.0

Annex II General description of the plankton samples.

GRID STATION	GENERAL DESCRIPTION OF PLANKTON SAMPLE
01-01	*Chysaora* (3): very little plankton, few copepods.
01-02	*Chysaora* (2); *Aequorea* (5); copepods and chaetognaths.
01-03	Good haul of euphausiids; *Aequorea* (3); *Chysaora* (1).
02-01	*Chysaora* (1); *Aequorea* (1) ; several small juvenile jellyfish; few copepods and cumaceans.
02-02	*Chysaora* (2), juvenile translucent jellyfish (8) and few copepods Juvenile horse mackerel (2) measuring between 32.0, 35.0 mm TL.
02-03	*Aequorea* (3); few copepods and chaetognaths.
02-04	*Chysaora* (1) ; copepods; chaetognaths, small squid.
03-01	*Chysaora* (1); few cumaceans; pelagic goby post larva 30.0 mm TL, very little plankton.
03-02	*Aequorea* (1); juvenile translucent jellyfish (30): few copepods with chaetognaths.
03-03	*Aequorea* (1); several clear jelly fragments; some copepods and chaetognaths.
03-04	*Aequorea* (6); very little plankton.
03-05	Good haul of euphausiids: some copepods, hake larvae (2) 12.3.mm; 10.2 mm; goby larvae (1) 11.5 mm.
04-01	Juvenile translucent jellyfish (7), very little plankton.
04-02	Juvenile translucent jellyfish (75), *Aequorea* (4), some cumaceans, copepods and chaetognaths.
04-03	Good haul of plankton: Mainly small euphausiids and copepods. Hake larvae (3), 12.3 mm. 11.5mm and 10.2 mm TL goby larvae (1) 10.5 mm TL.*Aequorea* (10).
04-04	Good haul of plankton: Mainly small euphausiids, copepods, cumaceans, chaetognaths, some planktonic isopods: horse mackerel larvae (2), 8.5 mm, 9.8mm TL: Goby larva 10.5 mm.
04-05	Good haul of plankton: mixed composition of euphausiids copepods and chaetognaths: *Aequorea* (3).
05-01	Juvenile translucent jellyfish (5). Sole juvenile, *Austroglossus* sp. (1), some copepods and chaetognaths. Low volume of plankton.

05-02	*Aequorea* (3): Juvenile aequorea (12); some copepods, chaetognaths and jelly fragments.
05-03	*Aequorea* (6): few copepods and chaetognaths.
05-04	*Aequorea* (3): Good haul of euphausiids, copepods, isopods, cumaceans and chaetognaths.
05-05	*Aequorea* (1): Sample consisted of mainly copepods, euphausiids and chaetognaths.
05-06	Small plankton volume consisting of copepods and euphausiids and jellyfish fragments.
05-07	Small plankton volume consisting of copepods, euphausiids and chaetognaths.
06-01	*Aequorea* (2); fragments of small jellyfish; Little plankton, mainly Fragilaria clumps and few copepods.
06-02	*Aequorea* (10); Small translucent jellyfish (51); Good haul of copepods with small quantities of euphausids and chaetognaths.
06-03	*Aequorea* (1), Small translucent jellyfish (23); low quantities of plankton, mainly copepods. A few cumaceans and amphipods with chaetognaths. Two horse mackerel larvae, 6.5 mm, 9.8 mm TL.
06-04	Good haul consisting mostly of copepods with a few amphipods and chaetognaths. No jellyfish.
06-05	Good haul of mostly copepods with chaetognaths and a few amphipods; Horse mackerel larva (1), 5.2 mm TL.
07-01	Good haul of Fragilaria (phytoplankton/ chain forming diatoms), minor quantities of copepods and jellyfish.
07-02	Aequorea (17); small translucent jellyfish (17); Copepods predominating with small amounts of euphausiids and amphipods. Goby post larva (1), 45 mm TL; Saury post larvae 55 mm TL.
07-03	Good haul consisting mostly of small euphausiids. Small quantities of copepods and chaetognaths; Goby post larvae, 45 mm , 60 mm TL.
07-04	*Aequorea* sp.(17); *Chrysosara* (3); Mostly copepods (90%)with few euphausiids (*E. hansii*); Goby larva, 20 mm TL.
07-05	*Aequorea* sp.(5); Mostly copepods (90%) with a few euphausiids and chaetognaths; Horse mackerel larvae (6) ranging in size from 5.2 to 8.0 mm TL.
07-06	*Aequorea* sp.(6); Good haul of copepods and chaetognaths; Horse mackerel larvae (6), ranging in size from 6.0 - 8.0 mm TL.
07-07	*Aequorea* sp. (2); Good haul of copepods with a few euphausiids (*E. hansii*), some chaetognaths; Horse mackerel larva(1), 8 mm TL.
08-01	*Aequorea* sp. (3); small transparent jellyfish (4); some clumps of Fragilaria; Mostly copepods with some chaetognaths.

08-02	*Aequorea* sp. (5); Mostly copepods, some chaetognaths with few small euphausiids.
08-03	*Aequorea* sp. (7); Mainly copepods with some planktonic stages of gastropods and Fragilaria clumps.
08-04	*Aequorea* juveniles (41); Mostly copepods with some small euphausiids and chaetognaths and planktonic gastropods; Horse mackerel larvae (3), 5.0 mm, 10.5 mm and 15.0 mm TL.
08-05 A	*Aequorea* sp. (2); Good haul of plankton predominantly copepods with some chaetognaths.
08-05 B	Good haul consisting mainly of copepods with a few large euphausiids.
09-01	*Aequorea* juveniles (24); Mostly copepods with mixture of chaetognaths and cumaceans; jellyfish slime.
09-02	*Aequorea* juveniles (16); Mostly a mixture of copepods and small euphausiids with some chaetognaths.
09-03	*Aequorea* sp. (2); Good haul with mixture of copepods, small euphausiids and chaetognaths; Saury (2), 45.0 mm, 50.0 mm TL.
09-04	*Aequorea* sp. (1); Good mixture of copepods, small euphausiids and chaetognaths; anchovy larva, 18.0 mm TL.
09-05	Mostly copepods with a few large euphausiids and chaetognaths.
10-01	*Aequorea* sp. (7); Mostly copepods with some small euphausiids and chaetognaths. Abundant planktonic gastropods.
10-02	Large haul of copepods mixed with some euphausiids and chaetognaths; Very abundant planktonic gastropods; horse mackerel post larva, 16.5 mm TL; Blennidae larvae (2) 18.0 mm, 20,0 mm TL.
10-03	Aequorea sp. (10); Mostly copepods with small quantities of euphausiids and chaetognaths; Abundant planktonic gastropods.
10-04	Mostly consist of copepods with some small euphausiids and chaetognaths.
10-05	Mainly copepods with few large euphausiids; Abundant planktonic gastropods, *Diaphus* (1) 12.0 mm TL.

Annex III Records of fishing stations

PROJECT STATION:1497
DATE: 4/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2447
start stop duration Long E 1407
TIME :01:48:00 02:18:00 30 (min) Purpose code: 1
LOG :2665.80 2667.36 1.56 Area code : 2
FDEPTH: 80 77 GearCond.code: 1
BDEPTH: 159 169 Validity code: 1
Towing dir: 240° Wire out: 250 m Speed: 3 kn*10

Sorted: Kg Total catch: 120.00 CATCH/HOUR: 240.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	230.02	127788	95.84	5141
Merluccius capensis, juveniles	8.32	610	3.47	5139
Todarodes sagittatus	1.66	56	0.69	
Total	240.00		100.00	

PROJECT STATION:1498
DATE: 4/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2345
start stop duration Long E 1406
TIME :03:06:00 03:13:00 7 (min) Purpose code: 1
LOG :2671.00 2671.40 0.40 Area code : 2
FDEPTH: 10 10 GearCond.code:
BDEPTH: 161 163 Validity code:
Towing dir: 242° Wire out: 160 m Speed: 3 kn*10

Sorted: Kg Total catch: 0.84 CATCH/HOUR: 7.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	3.09	1029	42.92	5140
Trachipterus trachypterus	2.83	9	39.31	
Schedophilus pemarco	0.60	9	8.33	
Todarodes sagittatus	0.43	17	5.97	
Sufflogobius bibarbatus	0.17	51	2.36	
ARGONAUTIDAE	0.09	9	1.25	
Total	7.21		100.14	

PROJECT STATION:1499
DATE: 4/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2339
start stop duration Long E 1350
TIME :08:20:00 08:32:00 12 (min) Purpose code: 1
LOG :2713.10 2713.70 0.60 Area code : 2
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 179 180 Validity code:
Towing dir: 270° Wire out: 150 m Speed: 30 kn*10

Sorted: Kg Total catch: 0.51 CATCH/HOUR: 2.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
ARGONAUTIDAE	1.50	25	58.82	
Trachurus capensis, juvenile	1.00	290	39.22	5142
Sufflogobius bibarbatus	0.05	65	1.96	
Chrysaora sp.	0.00	250		
Aequorea aequorea	0.00	10000		
Total	2.55		100.00	

PROJECT STATION:1500
DATE: 4/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2338
start stop duration Long E 1348
TIME :10:28:00 10:32:00 4 (min) Purpose code: 1
LOG :2725.20 2725.40 0.20 Area code : 2
FDEPTH: 143 142 GearCond.code: 9
BDEPTH: 183 182 Validity code:
Towing dir: 240° Wire out: 370 m Speed: 30 kn*10

Sorted: Kg Total catch: 0.60 CATCH/HOUR: 9.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trigla lyra	3.60	15	40.00	
Trachurus capensis, juvenile	1.80	360	20.00	5143
Todaropsis eblanae	1.20	45	13.33	
Todarodes sagittatus	1.20	30	13.33	
Schedophilus huttoni	1.20	15	13.33	
Chrysaora sp.	0.00	3000		
Aequorea aequorea	0.00	6000		
Total	9.00		99.99	

PROJECT STATION:1501
DATE: 4/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2338
start stop duration Long E 1347
TIME :11:23:00 11:32:00 9 (min) Purpose code: 1
LOG :2728.80 2729.22 0.42 Area code : 2
FDEPTH: 149 150 GearCond.code:
BDEPTH: 187 188 Validity code:
Towing dir: 230° Wire out: 410 m Speed: 30 kn*10

Sorted: Kg Total catch: 0.88 CATCH/HOUR: 5.87

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	4.47	2680	76.15	5145
Trachurus capensis, juvenile	1.40	320	23.85	5144
Chrysaora sp.	0.00	1333		
Aequorea aequorea	0.00	2667		
Total	5.87		100.00	

PROJECT STATION:1502
DATE: 4/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2325
start stop duration Long E 1409
TIME :15:11:00 15:17:00 6 (min) Purpose code: 1
LOG :2758.44 2758.78 0.34 Area code : 2
FDEPTH: 40 40 GearCond.code: 1
BDEPTH: 132 132 Validity code:
Towing dir: 235° Wire out: 150 m Speed: 3 kn*10

Sorted: 4 Kg Total catch: 4.04 CATCH/HOUR: 40.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	39.00	42510	96.53	5148
Trachurus capensis, juvenile	1.20	190	2.97	5146
Merluccius capensis, juveniles	0.20	30	0.50	5147
Chrysaora sp.	0.00	3000		
Aequorea aequorea	0.00	6000		
Total	40.40		100.00	

PROJECT STATION:1503
DATE: 4/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2326
start stop duration Long E 1409
TIME :16:02:00 16:08:00 6 (min) Purpose code: 1
LOG :2761.07 2761.44 0.37 Area code : 2
FDEPTH: 75 75 GearCond.code:
BDEPTH: 132 132 Validity code:
Towing dir: 63° Wire out: 200 m Speed: 37 kn*10

Sorted: 56 Kg Total catch: 0.56 CATCH/HOUR: 5.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	2.60	800	46.43	5151
Trachurus capensis, juvenile	1.90	340	33.93	5150
Merluccius capensis, juveniles	0.60	60	10.71	5149
Todaropsis eblanae	0.50	30	8.93	
Chrysaora sp.	0.00	500		
Aequorea aequorea	0.00	1000		
Total	5.60		100.00	

PROJECT STATION:1504
DATE: 4/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2319
start stop duration Long E 1416
TIME :18:14:00 18:21:00 7 (min) Purpose code: 1
LOG :2776.60 2776.90 0.30 Area code : 2
FDEPTH: 0 0 GearCond.code: 9
BDEPTH: 97 98 Validity code:
Towing dir: 270° Wire out: 150 m Speed: 30 kn*10

Sorted: 2 Kg Total catch: 2.03 CATCH/HOUR: 17.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	14.40	1680	82.76	5152
Sufflogobius bibarbatus	3.00	180	17.24	5153
Chrysaora sp.	0.00	8571		
Aequorea aequorea	0.00	4286		
Total	17.40		100.00	

PROJECT STATION:1505
DATE: 4/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2319
start stop duration Long E 1401
TIME :20:49:00 20:59:00 10 (min) Purpose code: 1
LOG :2706.10 2706.70 0.60 Area code : 2
FDEPTH: 40 50 GearCond.code: 1
BDEPTH: 147 149 Validity code:
Towing dir: 270° Wire out: 180 m Speed: 36 kn*10

Sorted: 22 Kg Total catch: 14.80 CATCH/HOUR: 88.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	84.00	63000	94.59	5154
Merluccius capensis, juveniles	3.00	180	3.38	5156
Trachurus capensis, juvenile	1.80	1260	2.03	5155
Chrysaora sp.	0.00	3000		
Aequorea aequorea	0.00	6000		
Total	88.80		100.00	

PROJECT STATION:1506
DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2316
start stop duration Long E 1339
TIME :01:46:00 01:54:00 8 (min) Purpose code: 1
LOG :2834.52 2839.90 0.38 Area code : 2
FDEPTH: 80 90 GearCond.code:
BDEPTH: 160 160 Validity code:
Towing dir: 243° Wire out: 320 m Speed: 29 kn*10

Sorted: Kg Total catch: 4.47 CATCH/HOUR: 33.53

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	22.50	825	67.10	5157
Sufflogobius bibarbatus	4.35	1005	12.97	5158
Todaropsis eblanae	3.30	75	9.84	
Trachurus capensis, juvenile	1.80	345	5.37	5159
Trigla lyra	1.58	8	4.71	
Chrysaora sp.	0.00	4500		
Aequorea aequorea	0.00	9000		
Total	33.53		99.99	

PROJECT STATION:1507

DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2314
start stop duration Long E 1346
TIME :03:17:00 03:20:00 3 (min) Purpose code: 1
LOG :2844.83 2844.97 0.14 Area code : 2
FDEPTH: 50 50 GearCond.code: 1
BDEPTH: 160 160 Validity code:
Towing dir: 250° Wire out: 155 m Speed: 28 kn*10

Sorted: Kg Total catch: 0.50 CATCH/HOUR: 10.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	5.20	4160	52.00	5161
Trachurus capensis, juvenile	4.80	960	48.00	5160
Chrysaora sp.	0.00	6400		
Aequorea aequorea	0.00	3200		
Total	10.00		100.00	

PROJECT STATION:1508

DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2308
start stop duration Long E 1407
TIME :07:20:00 07:25:00 5 (min) Purpose code: 1
LOG :2882.00 2882.30 0.30 Area code : 2
FDEPTH: 40 50 GearCond.code: 1
BDEPTH: 131 131 Validity code:
Towing dir: 167° Wire out: 170 m Speed: 35 kn*10

Sorted: 1 Kg Total catch: 14.39 CATCH/HOUR: 172.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	150.00	105000	86.87	5163
Trachurus capensis, juvenile	22.68	216	13.13	5162
J E L L Y F I S H	0.00	9600		5164
Total	172.68		100.00	

PROJECT STATION:1509

DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2314
start stop duration Long E 1413
TIME :09:05:00 09:10:00 5 (min) Purpose code: 1
LOG :2896.90 2897.20 0.30 Area code : 2
FDEPTH: 50 50 GearCond.code:
BDEPTH: 112 112 Validity code:
Towing dir: 24° Wire out: 170 m Speed: 35 kn*10

Sorted: 2 Kg Total catch: 19.50 CATCH/HOUR: 234.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	198.00	19920	84.62	5165
Sufflogobius bibarbatus	26.40	2160	11.28	5166
Engraulis capensis	9.60	120	4.10	5167
J E L L Y F I S H	0.00	9600		
Total	234.00		100.00	

PROJECT STATION:1510

DATE: 5/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2907
start stop duration Long E 2308
TIME :10:28:00 10:40:00 12 (min) Purpose code: 1
LOG :2907.30 2907.90 0.60 Area code : 2
FDEPTH: 10 10 GearCond.code:
BDEPTH: 82 77 Validity code:
Towing dir: 97° Wire out: 150 m Speed: 30 kn*10

Sorted: Kg Total catch: 36.18 CATCH/HOUR: 180.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	180.75	15195	99.92	5169
Sufflogobius bibarbatus	0.15	15	0.08	5170
Chrysaora sp.	0.00	3000		
Aequorea aequorea	0.00	6000		
Total	180.90		100.00	

PROJECT STATION:1511

DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2300
start stop duration Long E 1416
TIME :13:28:00 13:35:00 7 (min) Purpose code: 1
LOG :2926.90 2927.21 0.31 Area code : 2
FDEPTH: 0 0 GearCond.code: 1
BDEPTH: 98 96 Validity code:
Towing dir: 80° Wire out: 150 m Speed: 26 kn*10

Sorted: 32 Kg Total catch: 160.88 CATCH/HOUR: 1378.97

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	1377.86	140100	99.92	5171
ARGONAUTIDAE	1.11	17	0.08	
Chrysaora sp.	0.00	429		
Aequorea aequorea	0.00	857		
Total	1378.97		100.00	

PROJECT STATION:1512

DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2300
start stop duration Long E 1400
TIME :15:52:00 15:58:00 6 (min) Purpose code: 1
LOG :2946.04 2946.40 0.36 Area code : 2
FDEPTH: 60 60 GearCond.code: 1
BDEPTH: 136 136 Validity code:
Towing dir: 100° Wire out:2203 m Speed: 36 kn*10

Sorted: 35 Kg Total catch: 62.70 CATCH/HOUR: 627.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Thyrsites atun	325.80	900	51.96	5172
Sufflogobius bibarbatus	299.90	230710	47.83	5173
Trachipterus trachypterus	0.80	10	0.13	5174
Todaropsis eblanae	0.30	10	0.05	5175
Sepia sp.	0.10	10	0.02	5176
Total	626.90		99.99	

PROJECT STATION:1513

DATE: 5/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2300
start stop duration Long E 1332
TIME :19:27:00 19:51:00 24 (min) Purpose code: 1
LOG :2974.20 2975.40 1.20 Area code : 2
FDEPTH: 135 160 GearCond.code:
BDEPTH: 167 205 Validity code:
Towing dir: 270° Wire out: 320 m Speed: 30 kn*10

Sorted: 7 Kg Total catch: 281.00 CATCH/HOUR: 702.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	347.50	34750	49.47	5174
Merluccius capensis, juveniles	176.00	5700	25.05	5178
Chatrabus melanurus	144.00	3700	20.50	5175
Thyrsites atun	27.00	100	3.84	5177
Trachurus capensis, juvenile	5.00	200	0.71	5176
Lepidopus caudatus	3.00	100	0.43	5179
J E L L Y F I S H	0.00	40000		5180
Total	702.50		100.00	

PROJECT STATION:1514

DATE: 6/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2249
start stop duration Long E 1400
TIME :00:01:00 00:07:00 6 (min) Purpose code: 1
LOG :3007.96 3008.17 0.21 Area code : 2
FDEPTH: 70 70 GearCond.code: 1
BDEPTH: 127 128 Validity code:
Towing dir: 70° Wire out: 200 m Speed: 21 kn*10

Sorted: Kg Total catch: 16.19 CATCH/HOUR: 161.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	150.00	100230	92.65	5180
Merluccius capensis, juveniles	6.20	630	3.83	5179
Todaropsis eblanae	3.10	110	1.91	
Thyrsites atun	2.60	10	1.61	5181
J E L L Y F I S H	0.00	800		
Total	161.90		100.00	

PROJECT STATION:1515

DATE: 6/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2239
start stop duration Long E 1420
TIME :03:41:00 03:55:00 14 (min) Purpose code: 1
LOG :3038.37 3039.22 0.85 Area code : 2
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 63 67 Validity code:
Towing dir: 270° Wire out: 150 m Speed: 36 kn*10

Sorted: 5 Kg Total catch: 45.14 CATCH/HOUR: 193.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	192.86	8919	99.69	5182
ARGONAUTIDAE	0.30	4	0.16	
Sufflogobius bibarbatus	0.13	64	0.07	5183
Todarodes sagittatus	0.13	4	0.07	
Austroglossus microlepis	0.04	4	0.02	
J E L L Y F I S H	0.00	857		
Total	193.46		100.01	

PROJECT STATION:1516

DATE: 6/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2239
start stop duration Long E 1346
TIME :08:47:00 09:12:00 25 (min) Purpose code: 1
LOG :3075.30 3076.60 1.30 Area code : 2
FDEPTH: 105 104 GearCond.code: 3
BDEPTH: 131 130 Validity code:
Towing dir: 90° Wire out: 260 m Speed: 3 kn*10

Sorted: 120 Kg Total catch: 120.01 CATCH/HOUR: 288.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	288.00	192	99.99	
Trachurus capensis, juvenile	0.02	2	0.01	5184
Total	288.02		100.00	

PROJECT STATION:1517

DATE: 6/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2236
start stop duration Long E 1325
TIME :15:14:00 15:26:00 12 (min) Purpose code: 1
LOG :3125.78 3126.36 0.58 Area code : 2
FDEPTH: 244 240 GearCond.code: 1
BDEPTH: 244 240 Validity code:
Towing dir: 75° Wire out: 800 m Speed:348 kn*10

Sorted: 37 Kg Total catch: 210.32 CATCH/HOUR: 1051.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	802.20	7970	76.28	5185
Trachurus capensis, juvenile	168.00	1320	15.98	
Merluccius capensis, juveniles	51.30	2190	4.88	5186
Merluccius capensis	10.00	15	0.95	5187
Coelorinchus fasciatus	7.80	120	0.74	
Pterothrissus belloci	7.20	180	0.68	
Sufflogobius bibarbatus	5.10	1050	0.48	5188
Total	1051.60		99.99	

PROJECT STATION:1518

DATE: 6/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2234
start stop duration Long E 1330
TIME :16:36:00 17:08:00 32 (min) Purpose code: 1
LOG :3133.37 3135.00 1.63 Area code : 2
FDEPTH: 80 72 GearCond.code:
BDEPTH: 187 207 Validity code:
Towing dir: 240° Wire out: 240 m Speed: 31 kn*10

Sorted: 9 Kg Total catch: 9.90 CATCH/HOUR: 18.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Thyrsites atun	14.81	24	79.80	5189
Callorhinchus capensis	2.66	2	14.33	
Todaropsis eblanae	1.09	21	5.87	
J E L L Y F I S H	0.00	31875		
Total	18.56		100.00	

PROJECT STATION:1519

DATE: 6/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2231
start stop duration Long E 1337
TIME :18:37:00 18:53:00 16 (min) Purpose code: 1
LOG :3146.00 3146.70 0.70 Area code : 2
FDEPTH: 5 5 GearCond.code:
BDEPTH: 135 135 Validity code:
Towing dir: 251° Wire out: 150 m Speed: 3 kn*10

Sorted: 6 Kg Total catch: 6.47 CATCH/HOUR: 24.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Thyrsites atun	20.06	56	82.69	5191
Trachurus, Juveniles	3.00	574	12.37	5192
Merluccius capensis, juveniles	0.56	56	2.31	5190
Todaropsis eblanae	0.38	8	1.57	
Todarodes sagittatus	0.15	4	0.62	
Lepidopus caudatus	0.11	4	0.45	
J E L L Y F I S H	0.00	56250		
Total	24.26		100.01	

PROJECT STATION:1520

DATE: 7/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2220
start stop duration Long E 1315
TIME :00:21:00 00:36:00 15 (min) Purpose code: 1
LOG :3195.20 3196.10 2.20 Area code : 2
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 45 43 Validity code:
Towing dir: 90° Wire out: 150 m Speed: 36 kn*10

Sorted: Kg Total catch: 611.00 CATCH/HOUR: 2444.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	1924.00	285920	78.72	5194
Etrumeus whiteheadi	520.00	28880	21.28	5193
Chrysaora sp.	0.00	160		
Total	2444.00		100.00	

PROJECT STATION:1521

DATE: 6/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2219
start stop duration Long E 1343
TIME :04:38:00 04:44:00 6 (min) Purpose code: 1
LOG :3230.21 3230.50 0.29 Area code : 2
FDEPTH: 60 60 GearCond.code:
BDEPTH: 127 127 Validity code:
Towing dir: 270° Wire out: 220 m Speed: 29 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora sp.	0.00	600000		
Aequorea aequorea	0.00	100000		
J E L L Y F I S H	0.00	700000		
Total				

PROJECT STATION:1522

DATE: 7/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2219
start stop duration Long E 1330
TIME :06:46:00 07:02:00 16 (min) Purpose code: 1
LOG :3245.80 3246.70 0.90 Area code : 2
FDEPTH: 155 152 GearCond.code:
BDEPTH: 155 152 Validity code:
Towing dir: 90° Wire out: 500 m Speed: 32 kn*10

Sorted: 3 Kg Total catch: 123.06 CATCH/HOUR: 461.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	460.39	280418	99.76	5195
Merluccius capensis, juveniles	1.09	90	0.24	5196
Total	461.48		100.00	

PROJECT STATION:1523

DATE: 7/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2214
start stop duration Long E 1332
TIME :10:50:00 11:00:00 10 (min) Purpose code: 1
LOG :3276.20 3276.62 0.42 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 143 143 Validity code:
Towing dir: 66° Wire out: 280 m Speed: 25 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora sp.	0.00	1200		
Aequorea aequorea	0.00	2400		
Total				

PROJECT STATION:1524

DATE: 6/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2200
start stop duration Long E 1402
TIME :14:54:00 15:05:00 11 (min) Purpose code: 1
LOG :3312.20 3312.81 0.61 Area code : 2
FDEPTH: 5 5 GearCond.code:
BDEPTH: 40 40 Validity code:
Towing dir: 100° Wire out: 160 m Speed: 3 kn*10

Sorted: 15 Kg Total catch: 47.25 CATCH/HOUR: 257.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	256.91	18867	99.68	5197
PORTUNIDAE	0.82	16	0.32	
Chrysaora sp.	0.00	10909		
Total	257.73		100.00	

PROJECT STATION:1525

DATE: 6/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2200
start stop duration Long E 1340
TIME :18:12:00 18:20:00 8 (min) Purpose code: 1
LOG :3336.10 3336.50 0.40 Area code : 2
FDEPTH: 5 5 GearCond.code: 1
BDEPTH: 117 117 Validity code:
Towing dir: 270° Wire out: 150 m Speed: 31 kn*10

Sorted: 1 Kg Total catch: 1.21 CATCH/HOUR: 9.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	5.63	1185	62.00	5199
Sufflogobius bibarbatus	2.70	1470	29.74	5198
ARGONAUTIDAE	0.45	8	4.96	
Brama japonica	0.30	8	3.30	
Total	9.08		100.00	

PROJECT STATION:1526

DATE: 7/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2160
start stop duration Long E 1309
TIME :22:38:00 22:55:00 17 (min) Purpose code: 1
LOG :3368.00 3369.00 1.00 Area code : 2
FDEPTH: 115 105 GearCond.code:
BDEPTH: 211 202 Validity code:
Towing dir: 90° Wire out: 320 m Speed: 36 kn*10

Sorted: 17 Kg Total catch: 22.72 CATCH/HOUR: 80.19

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	43.06	491	53.70	5201
Merluccius capensis	20.01	307	24.95	5200
Lepidopus caudatus	16.69	141	20.81	5202
Brama japonica	0.42	4	0.52	
Aequorea aequorea	0.00	282353		
Total	80.18		99.98	

DATE: 8/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1527
POSITION:Lat S 2160
Long E 1309

	start	stop	duration		
TIME	:23:44:00	23:54:00	10	(min)	Purpose code: 1
LOG	:3370.96	3371.47	0.51		Area code : 2
FDEPTH:	212	215			GearCond.code:
BDEPTH:	212	215			Validity code:

Towing dir: 265° Wire out: 700 m Speed: 31 kn*10

Sorted: 34 Kg Total catch: 154.34 CATCH/HOUR: 926.04

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	737.10	6534	79.60	5203
Trachurus capensis	129.60	1218	14.00	5204
Pterothrissus belloci	50.52	1080	5.46	5205
Sufflogobius bibarbatus	7.02	1164	0.76	
Austroglossus microlepis	1.80	6	0.19	
Chrysaora sp.	0.00	1800		
Aequorea aequorea	0.00	36000		
Total	926.04		100.01	

DATE: 8/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1528
POSITION:Lat S 2156
Long E 1259

	start	stop	duration		
TIME	:03:22:00	03:27:00	5	(min)	Purpose code: 1
LOG	:3394.76	3394.99	0.23		Area code : 2
FDEPTH:	20	20			GearCond.code:
BDEPTH:	306	306			Validity code:

Towing dir: 70° Wire out: 80 m Speed: 28 kn*10

Sorted: Kg Total catch: 0.08 CATCH/HOUR: 0.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	0.96	600	100.00	
Chrysaora sp.	0.00	12000		
Aequorea aequorea	0.00	54000		
Total	0.96		100.00	

DATE: 8/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1529
POSITION:Lat S 2139
Long E 1346

	start	stop	duration		
TIME	:09:19:00	09:29:00	10	(min)	Purpose code: 1
LOG	:3451.60	3452.10	0.50		Area code : 2
FDEPTH:	22	23			GearCond.code: 1
BDEPTH:	63	59			Validity code:

Towing dir: 90° Wire out: 90 m Speed: 31 kn*10

Sorted: 26 Kg Total catch: 159.46 CATCH/HOUR: 956.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	936.00	51366	97.83	5206
Etrumeus whiteheadi	20.76	666	2.17	5207
Total	956.76		100.00	

DATE: 8/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1530
POSITION:Lat S 2140
Long E 1312

	start	stop	duration		
TIME	:14:25:00	14:45:00	20	(min)	Purpose code: 1
LOG	:3490.94	3491.83	0.89		Area code : 2
FDEPTH:	162	158			GearCond.code:
BDEPTH:	162	158			Validity code:

Towing dir: 100° Wire out: 550 m Speed: 27 kn*10

Sorted: 52 Kg Total catch: 876.40 CATCH/HOUR: 2629.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1661.10	17976	63.18	5209
Merluccius capensis, juveniles	447.30	15162	17.01	5208
Merluccius capensis	428.40	3990	16.29	5210
Sufflogobius bibarbatus	47.04	7098	1.79	
Trigla lyra	31.92	84	1.21	
Pterothrissus belloci	7.56	12	0.29	
Todaropsis eblanae	4.20	126	0.16	
PORTUNIDAE	0.84	42	0.03	
Chatrabus melanurus	0.84	42	0.03	
J E L L Y F I S H	0.00	300		
Total	2629.20		99.99	

DATE: 8/ 6/96 GEAR TYPE: PT No:2 PROJECT STATION:1531
POSITION:Lat S 2139
Long E 1257

	start	stop	duration		
TIME	:18:00:00	18:05:00	5	(min)	Purpose code: 1
LOG	:3511.70	3511.90	0.20		Area code : 2
FDEPTH:	0	0			GearCond.code: 1
BDEPTH:	288	287			Validity code:

Towing dir: 66° Wire out: 150 m Speed: 28 kn*10

Sorted: 2 Kg Total catch: 17.49 CATCH/HOUR: 209.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus hudsoni	207.00	16380	98.63	
Merluccius capensis, juveniles	2.88	156	1.37	5211
Total	209.88		100.00	

DATE: 8/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1532
POSITION:Lat S 2122
Long E 1334

	start	stop	duration		
TIME	:22:09:00	22:18:00	9	(min)	Purpose code: 1
LOG	:3549.90	3550.50	0.50		Area code : 2
FDEPTH:	20	23			GearCond.code: 1
BDEPTH:	83	80			Validity code: 4

Towing dir: 64° Wire out: 90 m Speed: 31 kn*10

Sorted: 14 Kg Total catch: 28.00 CATCH/HOUR: 186.67

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	100.67	7287	53.93	5212
Trachurus capensis	86.00	6493	46.07	5213
Total	186.67		100.00	

DATE: 9/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1533
POSITION:Lat S 2120
Long E 1320

	start	stop	duration		
TIME	:01:46:00	01:52:00	6	(min)	Purpose code: 1
LOG	:3578.16	3578.48	0.32		Area code : 2
FDEPTH:	30	30			GearCond.code:
BDEPTH:	118	118			Validity code:

Towing dir: 90° Wire out: 100 m Speed: 32 kn*10

Sorted: 28 Kg Total catch: 144.75 CATCH/HOUR: 1447.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1447.50	20350	100.00	5214
Chrysaora sp.	0.00	2000		
Aequorea aequorea	0.00	350000		
Total	1447.50		100.00	

DATE: 9/ 5/96 GEAR TYPE: BT No:4 PROJECT STATION:1534
POSITION:Lat S 2112
Long E 1303

	start	stop	duration		
TIME	:07:39:00	07:46:00	7	(min)	Purpose code: 1
LOG	:3624.00	3624.40	0.40		Area code : 2
FDEPTH:	160	161			GearCond.code: 1
BDEPTH:	160	161			Validity code: 4

Towing dir: 230° Wire out: 500 m Speed: 3 kn*10

Sorted: 29 Kg Total catch: 786.70 CATCH/HOUR: 6743.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	6251.14	62083	92.70	5215
Merluccius capensis, juveniles	327.43	3377	4.86	5217
Merluccius capensis, juveniles	153.43	2889	2.28	5216
Sufflogobius bibarbatus	11.14	891	0.17	
Total	6743.14		100.01	

DATE: 9/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1535
POSITION:Lat S 2104
Long E 1316

	start	stop	duration		
TIME	:09:56:00	10:23:00	27	(min)	Purpose code: 1
LOG	:3642.80	3644.70	1.90		Area code : 2
FDEPTH:	20	20			GearCond.code:
BDEPTH:	118	119			Validity code:

Towing dir: 239° Wire out: 100 m Speed: 40 kn*10

Sorted: Kg Total catch: 0.70 CATCH/HOUR: 1.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	1.56	593	100.00	5218
Chrysaora sp.	0.00	4444		
Aequorea aequorea	0.00	22222		
Total	1.56		100.00	

DATE: 9/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1536
POSITION:Lat S 2059
Long E 1300

	start	stop	duration		
TIME	:14:48:00	15:03:00	15	(min)	Purpose code: 1
LOG	:3681.19	3681.98	0.79		Area code : 2
FDEPTH:	161	170			GearCond.code:
BDEPTH:	161	170			Validity code:

Towing dir: 270° Wire out: 520 m Speed: 32 kn*10

Sorted: 34 Kg Total catch: 269.00 CATCH/HOUR: 1076.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	528.00	6304	49.07	5219
Sufflogobius bibarbatus	257.60	24144	23.94	
Merluccius capensis	235.20	1856	21.86	5221
Merluccius capensis, juveniles	55.20	1664	5.13	5220
Aequorea aequorea	0.00	16000		
Total	1076.00		100.00	

PROJECT STATION: 1537

DATE: 9/ 5/96 GEAR TYPE: PT No:2 POSITION: Lat S 2107

	start	stop	duration			Long E 1255
TIME	:21:23:00	21:31:00	8 (min)	Purpose code:	1	
LOG	:3733.10	3733.50	0.40	Area code :	2	
FDEPTH:	5	5		GearCond.code:		
BDEPTH:	274	276		Validity code:		

Towing dir: 270° Wire out: 150 m Speed: 30 kn*10

Sorted: 1 Kg Total catch: 34.61 CATCH/HOUR: 259.58

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Diaphus hudsoni	155.93	15593	60.07	
Trachurus capensis, juvenile	75.15	25328	28.95	5223
Taractes rubescens	22.80	8	8.78	
Merluccius capensis	5.70	53	2.20	5222
Chrysaora sp.	0.00	15000		
Aequorea aequorea	0.00	375000		
Total	259.58		100.00	

PROJECT STATION: 1538

DATE: 9/ 5/96 GEAR TYPE: PT No:1 POSITION: Lat S 2108

	start	stop	duration			Long E 1305
TIME	:22:55:00	23:03:00	8 (min)	Purpose code:	1	
LOG	:3744.20	3744.70	0.50	Area code :	2	
FDEPTH:	98	95		GearCond.code:		
BDEPTH:	133	132		Validity code:		

Towing dir: 90° Wire out: 2003 m Speed: 33 kn*10

Sorted: 21 Kg Total catch: 50.93 CATCH/HOUR: 381.98

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	362.40	6398	94.87	5224
Merluccius capensis	14.40	128	3.77	5226
Merluccius capensis, juveniles	4.28	165	1.12	5225
MYCTOPHIDAE	0.90	398	0.24	
Chrysaora sp.	0.00	1500		
Aequorea aequorea	0.00	375000		
Total	381.98		100.00	

PROJECT STATION: 1539

DATE: 10/ 5/96 GEAR TYPE: PT No:1 POSITION: Lat S 2123

	start	stop	duration			Long E 1314
TIME	:01:44:00	01:50:00	6 (min)	Purpose code:	1	
LOG	:3768.35	3768.68	0.33	Area code :	2	
FDEPTH:	90	90		GearCond.code:		
BDEPTH:	132	132		Validity code:		

Towing dir: 340° Wire out: 300 m Speed: 30 kn*10

Sorted: 11 Kg Total catch: 46.80 CATCH/HOUR: 468.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	274.00	4080	58.55	5227
Merluccius capensis, juveniles	194.00	7600	41.45	5228
Chrysaora sp.	0.00	4000		
Aequorea aequorea	0.00	1000000		
Total	468.00		100.00	

PROJECT STATION: 1540

DATE: 10/ 5/96 GEAR TYPE: PT No:2 POSITION: Lat S 2123

	start	stop	duration			Long E 1249
TIME	:04:47:00	04:55:00	8 (min)	Purpose code:	1	
LOG	:3795.50	3795.91	0.41	Area code :	2	
FDEPTH:	5	5		GearCond.code:		
BDEPTH:	318	318		Validity code:		

Towing dir: 270° Wire out: 150 m Speed: 30 kn*10

Sorted: 1 Kg Total catch: 7.45 CATCH/HOUR: 55.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Prionace glauca	29.63	15	53.02	
Brama brama	22.20	45	39.73	
Diaphus hudsoni	3.45	2033	6.17	
Trachurus capensis, juvenile	0.60	278	1.07	5229
Total	55.88		99.99	

PROJECT STATION: 1541

DATE: 10/ 5/96 GEAR TYPE: BT No:9 POSITION: Lat S 2116

	start	stop	duration			Long E 1258
TIME	:07:24:00	07:38:00	14 (min)	Purpose code:	1	
LOG	:3817.50	3818.20	0.70	Area code :	2	
FDEPTH:	243	239		GearCond.code:		
BDEPTH:	243	239		Validity code:		

Towing dir: 160° Wire out: 800 m Speed: 30 kn*10

Sorted: 1 Kg Total catch: 51.06 CATCH/HOUR: 218.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	192.17	2040	87.82	5230
Sufflogobius bibarbatus	25.71	4564	11.75	5232
Trachurus capensis	0.51	4	0.23	
Pterothrissus belloci	0.26	17	0.12	
Trachurus capensis, juvenile	0.13	47	0.06	5231
Solenocera africana	0.00			
Chrysaora sp.	0.00	3857		
Total	218.78		99.98	

PROJECT STATION: 1542

DATE: 10/ 5/96 GEAR TYPE: PT No:1 POSITION: Lat S 2116

	start	stop	duration			Long E 1259
TIME	:08:21:00	08:30:00	9 (min)	Purpose code:	1	
LOG	:3826.10	3826.60	0.50	Area code :	2	
FDEPTH:	25	25		GearCond.code:	1	
BDEPTH:	232	225		Validity code:		

Towing dir: 160° Wire out: 90 m Speed: 31 kn*10

Sorted: Kg Total catch: 0.56 CATCH/HOUR: 3.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis, juvenile	3.73	22400	100.00	1533
Chrysaora sp.	0.00	200		
Aequorea aequorea	0.00	2000		
Total	3.73		100.00	

PROJECT STATION: 1543

DATE: 10/ 5/96 GEAR TYPE: BT No:9 POSITION: Lat S 2116

	start	stop	duration			Long E 1306
TIME	:09:46:00	09:55:00	9 (min)	Purpose code:	1	
LOG	:3829.90	3830.30	0.40	Area code :	2	
FDEPTH:	145	145		GearCond.code:	1	
BDEPTH:	145	145		Validity code:		

Towing dir: 160° Wire out: 500 m Speed: 30 kn*10

Sorted: 34 Kg Total catch: 6808.50 CATCH/HOUR: 45390.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	44693.34	538567	98.47	5235
Merluccius capensis	696.67	34833	1.53	5234
Total	45390.01		100.00	

PROJECT STATION: 1544

DATE: 10/ 5/96 GEAR TYPE: BT No:9 POSITION: Lat S 2116

	start	stop	duration			Long E 1314
TIME	:11:22:00	11:30:00	8 (min)	Purpose code:	1	
LOG	:3841.44	3841.84	0.40	Area code :	2	
FDEPTH:	128	128		GearCond.code:		
BDEPTH:	128	128		Validity code:		

Towing dir: 165° Wire out: 480 m Speed: 30 kn*10

Sorted: 65 Kg Total catch: 2027.09 CATCH/HOUR: 15203.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	13461.75	210653	88.55	5236
Merluccius capensis, juveniles	1662.38	39060	10.93	5238
Sufflogobius bibarbatus	62.78	9765	0.41	5237
Pterothrissus belloci	11.63	233	0.08	
Todaropsis eblanae	4.65	233	0.03	
Total	15203.19		100.00	

PROJECT STATION: 1545

DATE: 10/ 5/96 GEAR TYPE: BT No:9 POSITION: Lat S 2130

	start	stop	duration			Long E 1314
TIME	:13:35:00	13:50:00	15 (min)	Purpose code:	1	
LOG	:3860.42	3861.20	0.78	Area code :	2	
FDEPTH:	142	145		GearCond.code:		
BDEPTH:	142	145		Validity code:		

Towing dir: 266° Wire out: 500 m Speed: 31 kn*10

Sorted: 79 Kg Total catch: 5193.54 CATCH/HOUR: 20774.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	13107.60	160260	63.10	5239
Merluccius capensis, juveniles	7326.00	162956	35.26	5240
Sufflogobius bibarbatus	234.96	36208	1.13	5241
Chelidonichthys capensis	95.04	264	0.46	
Pterothrissus belloci	7.92	264	0.04	
Todaropsis eblanae	2.64	264	0.01	
J E L L Y F I S H	0.00	12000		
Total	20774.16		100.00	

PROJECT STATION: 1546

DATE: 10/ 5/96 GEAR TYPE: BT No:9 POSITION: Lat S 2131

	start	stop	duration			Long E 1302
TIME	:15:07:00	15:27:00	20 (min)	Purpose code:	1	
LOG	:3871.99	3873.05	1.06	Area code :	2	
FDEPTH:	230	238		GearCond.code:		
BDEPTH:	230	238		Validity code:		

Towing dir: 260° Wire out: 800 m Speed: 32 kn*10

Sorted: 88 Kg Total catch: 1187.04 CATCH/HOUR: 3561.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2154.60	20403	60.50	5243
Merluccius capensis	1356.75	14385	38.10	5242
Sufflogobius bibarbatus	38.46	5910	1.08	
Pterothrissus belloci	10.11	243	0.28	
Todaropsis eblanae	1.20	39	0.03	
Total	3561.12		99.99	

DATE:10/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1547
POSITION:Lat S 2130
Long E 1250

	start	stop	duration	
TIME	:16:52:00	17:14:00	22 (min)	Purpose code: 1
LOG	:3883.85	3885.05	1.20	Area code : 2
FDEPTH:	310	315		GearCond.code:
BDEPTH:	310	315		Validity code:

Towing dir: 260° Wire out: 980 m Speed: 31 kn*10

Sorted: 85 Kg Total catch: 96.92 CATCH/HOUR: 264.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	177.27	281	67.06	5245
Pterothrissus belloci	29.18	633	11.04	
Coelorinchus fasciatus	16.36	349	6.19	
Austroglossus microlepis	9.41	22	3.56	
Merluccius capensis, juveniles	8.97	169	3.39	5244
Dentex macrophthalmus	6.87	22	2.60	
Neoharriotta pinnata	6.00	5	2.27	
Todarodes sagittatus	4.25	5	1.61	
Galeus polli	3.44	55	1.30	
Krill	1.80		0.68	
Todaropsis eblanae	0.27	11	0.10	
Lophius vaillanti	0.27	5	0.10	
Sufflogobius bibarbatus	0.22	27	0.08	
Total	264.31		99.98	

DATE:10/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1548
POSITION:Lat S 2138
Long E 1302

	start	stop	duration	
TIME	:20:05:00	20:20:00	15 (min)	Purpose code: 1
LOG	:3905.20	3906.10	0.90	Area code : 2
FDEPTH:	70	82		GearCond.code:
BDEPTH:	257	262		Validity code:

Towing dir: 270° Wire out: 230 m Speed: 35 kn*10

Sorted: Kg Total catch: 6.91 CATCH/HOUR: 27.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	22.48	204	81.33	5247
Merluccius capensis	4.00	36	14.47	5248
Diaphus hudsoni	0.96	400	3.47	
Trachurus capensis, juvenile	0.12	36	0.43	5246
Lepidopus caudatus	0.08	4	0.29	
J E L L Y F I S H	0.00	3600		
Total	27.64		99.99	

DATE:10/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1549
POSITION:Lat S 2138
Long E 1314

	start	stop	duration	
TIME	:22:08:00	22:15:00	7 (min)	Purpose code: 1
LOG	:3921.10	3921.50	0.40	Area code : 2
FDEPTH:	20	22		GearCond.code:
BDEPTH:	151	153		Validity code:

Towing dir: 270° Wire out: 90 m Speed: 32 kn*10

Sorted: 9 Kg Total catch: 9.43 CATCH/HOUR: 80.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	71.06	891	87.91	5249
Merluccius capensis, juveniles	9.51	360	11.77	5251
Trachurus capensis, juvenile	0.26	69	0.32	5250
J E L L Y F I S H	0.00	7714		
Total	80.83		100.00	

DATE:11/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1550
POSITION:Lat S 2153
Long E 1315

	start	stop	duration	
TIME	:02:20:00	02:30:00	10 (min)	Purpose code: 1
LOG	:3960.13	3960.54	0.41	Area code : 2
FDEPTH:	100	100		GearCond.code:
BDEPTH:	166	166		Validity code:

Towing dir: 100° Wire out: 300 m Speed: 25 kn*10

Sorted: 1 Kg Total catch: 29.98 CATCH/HOUR: 179.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	120.48	1680	66.98	
Lepidopus caudatus	38.10	762	21.18	
Merluccius capensis	21.30	912	11.84	
Total	179.88		100.00	

DATE:11/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1551
POSITION:Lat S 2151
Long E 1301

	start	stop	duration	
TIME	:04:35:00	04:45:00	10 (min)	Purpose code: 1
LOG	:3978.14	3978.56	0.42	Area code : 2
FDEPTH:	220	220		GearCond.code:
BDEPTH:	280	280		Validity code:

Towing dir: 170° Wire out: 620 m Speed: 25 kn*10

Sorted: 4 Kg Total catch: 4.40 CATCH/HOUR: 26.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	24.42	138	92.50	5254
Trachurus capensis	1.74	12	6.59	5252
Pterothrissus belloci	0.18	6	0.68	
Trachurus, Juveniles	0.06	6	0.23	5253
J E L L Y F I S H	0.00	600000		
Total	26.40		100.00	

DATE:11/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1552
POSITION:Lat S 2147
Long E 1302

	start	stop	duration	
TIME	:06:18:00	06:48:00	30 (min)	Purpose code: 1
LOG	:3988.90	3990.50	1.60	Area code : 2
FDEPTH:	271	270		GearCond.code:
BDEPTH:	271	270		Validity code:

Towing dir: 160° Wire out: 850 m Speed: 32 kn*10

Sorted: 63 Kg Total catch: 168.34 CATCH/HOUR: 336.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	328.92	1702	97.70	5255
Sufflogobius bibarbatus	7.76	1848	2.30	5256
Aequorea aequorea	0.00	1800		
Total	336.68		100.00	

DATE:11/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1553
POSITION:Lat S 2148
Long E 1316

	start	stop	duration	
TIME	:08:17:00	08:25:00	8 (min)	Purpose code: 1
LOG	:4001.90	4002.30	0.40	Area code : 2
FDEPTH:	162	162		GearCond.code:
BDEPTH:	162	162		Validity code:

Towing dir: 90° Wire out: 520 m Speed: 3 kn*10

Sorted: 28 Kg Total catch: 346.50 CATCH/HOUR: 2598.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1953.00	21713	75.15	5259
Merluccius capensis	627.38	9818	24.14	5257
Pterothrissus belloci	12.08	263	0.46	
Sufflogobius bibarbatus	6.30	788	0.24	5258
J E L L Y F I S H	0.00	3000		
Total	2598.76		99.99	

DATE:11/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1554
POSITION:Lat S 2146
Long E 1321

	start	stop	duration	
TIME	:09:31:00	10:01:00	30 (min)	Purpose code: 1
LOG	:4010.80	4012.20	1.40	Area code : 2
FDEPTH:	149	149		GearCond.code:
BDEPTH:	149	149		Validity code:

Towing dir: 160° Wire out: 460 m Speed: 28 kn*10

Sorted: 19 Kg Total catch: 95.85 CATCH/HOUR: 191.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	187.50	2860	97.81	5261
Sufflogobius bibarbatus	2.30	860	1.20	5262
Trachurus capensis	1.90	20	0.99	5260
J E L L Y F I S H	0.00	1000		
Total	191.70		100.00	

DATE:11/ 5/96 GEAR TYPE: PT No:1 PROJECT STATION:1555
POSITION:Lat S 2157
Long E 1329

	start	stop	duration	
TIME	:12:10:00	12:20:00	10 (min)	Purpose code: 1
LOG	:4030.05	4030.60	0.55	Area code : 2
FDEPTH:	110	110		GearCond.code:
BDEPTH:	142	142		Validity code:

Towing dir: 340° Wire out: 300 m Speed: 33 kn*10

Sorted: 1 Kg Total catch: 22.50 CATCH/HOUR: 135.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	135.00	89610	100.00	5263
J E L L Y F I S H	0.00	3000		
Total	135.00		100.00	

DATE:11/ 5/96 GEAR TYPE: BT No:9 PROJECT STATION:1556
POSITION:Lat S 2200
Long E 1326

	start	stop	duration	
TIME	:13:33:00	13:53:00	20 (min)	Purpose code: 1
LOG	:4039.06	4040.17	1.11	Area code : 2
FDEPTH:	151	158		GearCond.code:
BDEPTH:	151	158		Validity code:

Towing dir: 266° Wire out: 520 m Speed: 30 kn*10

Sorted: 19 Kg Total catch: 161.71 CATCH/HOUR: 485.13

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	376.65	215718	77.64	5265
Merluccius capensis, juveniles	108.00	3321	22.26	5264
Chatrabus melanurus	0.48	6	0.10	
Total	485.13		100.00	

PROJECT STATION:1557

DATE:11/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2200
start stop duration Long E 1316
TIME :14:58:00 14:59:00 1 (min) Purpose code: 1
LOG :4048.49 4048.49 Area code : 2
FDEPTH: 171 172 GearCond.code: 9
BDEPTH: 171 172 Validity code:
Towing dir: 270° Wire out: 600 m Speed: kn*10

Sorted: 14 Kg Total catch: 15.37 CATCH/HOUR: 922.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	843.00	12540	91.41	5267
Sufflogobius bibarbatus	79.20	16920	8.59	5266
J E L L Y F I S H	0.00	1200		
Total	922.20		100.00	

PROJECT STATION:1558

DATE:11/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2159
start stop duration Long E 1513
TIME :15:55:00 16:03:00 8 (min) Purpose code: 1
LOG :4052.63 4053.10 0.47 Area code : 2
FDEPTH: 184 185 GearCond.code:
BDEPTH: 184 185 Validity code:
Towing dir: 260° Wire out: 620 m Speed: 35 kn*10

Sorted: 15 Kg Total catch: 3000.71 CATCH/HOUR: 22505.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	21323.63	256200	94.75	5268
Merluccius capensis	1098.38	12878	4.88	5269
Sufflogobius bibarbatus	83.33	9848	0.37	5270
Total	22505.34		100.00	

PROJECT STATION:1559

DATE:11/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2209
start stop duration Long E 1330
TIME :21:35:00 21:41:00 6 (min) Purpose code: 1
LOG :4103.20 4103.60 0.40 Area code : 2
FDEPTH: 20 20 GearCond.code: 1
BDEPTH: 145 145 Validity code: 4
Towing dir: 90° Wire out: 80 m Speed: 32 kn*10

Sorted: 10 Kg Total catch: 9.82 CATCH/HOUR: 98.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Thyrsites atun	89.50	250	91.14	
Trachipterus jacksonensis	7.00	20	7.13	
Trachurus, Juveniles	0.70	160	0.71	5271
Sufflogobius bibarbatus	0.50	20	0.51	5272
Merluccius capensis, juveniles	0.50	20	0.51	5273
J E L L Y F I S H	0.00	4000		
Total	98.20		100.00	

PROJECT STATION:1560

DATE:11/ 5/96 GEAR TYPE: PT No:2 POSITION:Lat S 2219
start stop duration Long E 1337
TIME :23:40:00 23:50:00 10 (min) Purpose code: 1
LOG :4119.38 4120.00 0.62 Area code : 2
FDEPTH: 10 10 GearCond.code:
BDEPTH: 134 134 Validity code:
Towing dir: 350° Wire out: 150 m Speed: 37 kn*10

Sorted: Kg Total catch: 83.65 CATCH/HOUR: 501.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Thyrsites atun	501.90	1452	100.00	5274
Chrysaora sp.	0.00	1200		
Aequorea aequorea	0.00	300000		
Total	501.90		100.00	

PROJECT STATION:1561

DATE:12/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2216
start stop duration Long E 1309
TIME :04:19:00 04:39:00 20 (min) Purpose code: 1
LOG :4164.43 4165.40 0.98 Area code : 2
FDEPTH: 240 243 GearCond.code:
BDEPTH: 240 243 Validity code:
Towing dir: 266° Wire out: 780 m Speed: 29 kn*10

Sorted: 35 Kg Total catch: 54.65 CATCH/HOUR: 163.95

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	89.55	636	54.62	5178
Sufflogobius bibarbatus	58.95	12576	35.96	5176
Trachurus capensis	12.90	117	7.87	5175
Merluccius capensis, juveniles	1.68	51	1.02	5177
Thyrsites atun	0.87	3	0.53	
J E L L Y F I S H	0.00	900		
Total	163.95		100.00	

PROJECT STATION:1562

DATE:12/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2216
start stop duration Long E 1325
TIME :07:04:00 07:21:00 17 (min) Purpose code: 1
LOG :4183.20 4184.10 0.90 Area code : 2
FDEPTH: 180 180 GearCond.code:
BDEPTH: 180 180 Validity code: 4
Towing dir: 160° Wire out: 560 m Speed: 3 kn*10

Sorted: 24 Kg Total catch: 146.16 CATCH/HOUR: 515.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	502.31	13384	97.37	5179
Sufflogobius bibarbatus	11.86	2541	2.30	5180
Todaropsis eblanae	1.06	21	0.21	
Sepia sp.	0.64	21	0.12	
Total	515.87		100.00	

PROJECT STATION:1563

DATE:12/ 5/96 GEAR TYPE: PT No:1 POSITION:Lat S 2215
start stop duration Long E 1339
TIME :09:42:00 09:47:00 5 (min) Purpose code: 1
LOG :4200.80 4201.10 0.30 Area code : 2
FDEPTH: 103 25 GearCond.code:
BDEPTH: 130 130 Validity code:
Towing dir: 270° Wire out: 300 m Speed: 35 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	0.00	7200		
Total				

PROJECT STATION:1564

DATE:12/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2230
start stop duration Long E 1344
TIME :13:06:00 13:36:00 30 (min) Purpose code: 1
LOG :4232.07 4233.52 1.45 Area code : 2
FDEPTH: 128 129 GearCond.code:
BDEPTH: 128 129 Validity code:
Towing dir: 266° Wire out: 500 m Speed: 29 kn*10

Sorted: 14 Kg Total catch: 66.28 CATCH/HOUR: 132.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	131.00	104254	98.82	5183
Merluccius capensis, juveniles	1.24	96	0.94	5181
Lepidopus caudatus	0.24	8	0.18	
Trachurus capensis, juvenile	0.08	20	0.06	5182
J E L L Y F I S H	0.00	600		
Total	132.56		100.00	

PROJECT STATION:1565

DATE:12/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2230
start stop duration Long E 1333
TIME :14:42:00 15:11:00 29 (min) Purpose code: 1
LOG :4242.23 4243.73 1.50 Area code : 2
FDEPTH: 140 140 GearCond.code:
BDEPTH: 140 140 Validity code:
Towing dir: 270° Wire out: 520 m Speed: 31 kn*10

Sorted: 14 Kg Total catch: 55.96 CATCH/HOUR: 115.78

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	104.28	23969	90.07	5185
Merluccius capensis	11.17	439	9.65	5184
Chatrabus melanurus	0.33	4	0.29	
Total	115.78		100.01	

PROJECT STATION:1566

DATE:12/ 5/96 GEAR TYPE: BT No:9 POSITION:Lat S 2230
start stop duration Long E 1320
TIME :16:27:00 16:57:00 30 (min) Purpose code: 1
LOG :4254.41 4256.09 1.68 Area code : 2
FDEPTH: 247 249 GearCond.code:
BDEPTH: 247 249 Validity code:
Towing dir: 255° Wire out: 820 m Speed: 33 kn*10

Sorted: 40 Kg Total catch: 1683.80 CATCH/HOUR: 3367.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	2601.00	22866	77.24	5186
Trachurus capensis	477.76	4846	14.19	5188
Merluccius capensis, juveniles	255.00	10370	7.57	5187
Sufflogobius bibarbatus	34.00	5866	1.01	5189
Aequorea aequorea	0.00	600		
Total	3367.76		100.01	

Annex IV Instruments and fishing gear used.

The Simrad EK-500, 38 kHz echo scientific sounder was used during the survey for fish abundance estimation. The Bergen Echo Integrator system (BEI) logging the echogram raw data from the echo sounder, was used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data was stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the 38 kHz were as follows:

Transceiver-1 menu	Transducer depth	0.0 m
	Absorbtion coeff.	10 dB/km
	Pulse length	medium
	Bandwidth	wide
	Max Power	2000 W
	2-way beam angle	-21.0 dB
	SV transducer gain	28.0 dB
	TS transducer gain	27.9 dB
	Angle sensitivity	21.9
	3 dB beamwidth	6.8 deg
	Alongship offset	0.00 deg
	Athwardship offset	0.04 deg
Display menu	Echogram	1
	Bottom range	12 m
	Bottom start	10 m
	TVG	20 log R
	SV Colour minimum	-67 dB
	TS Colour minimum	-50 dB
Printer settings	Range	0-100 or 0-250 m
	TVG	20 log R
	Sv Colour minimum	-72 dB
Bottom detection menu	-50 dB	

A calibration experiment using a standard copper sphere, performed in Baia dos Tigres 15 June 1995 gave the following results :

Sv Transducer gain 28.1 dB
Ts Transducer gain 28.0 dB

Hydrography

Conductivity, temperature, density and dissolved oxygen were sampled regularly at CTD stations with a Seabird 911+ CTD sonde. The salinity is computed from the data on conductivity by the software retrieving data from the sensors.

Fishing gear

The vessel has two different sized "Åkrehamn" pelagic trawls and one "Gisund super" bottom trawl. For all trawls, the Tyborøn, 7.8 m^2 (1670 kg) trawl doors were used. Complete drawings of the trawls used are included.

F/F Dr. Fridtjof Nansen

OVER/UNDER/SIDER

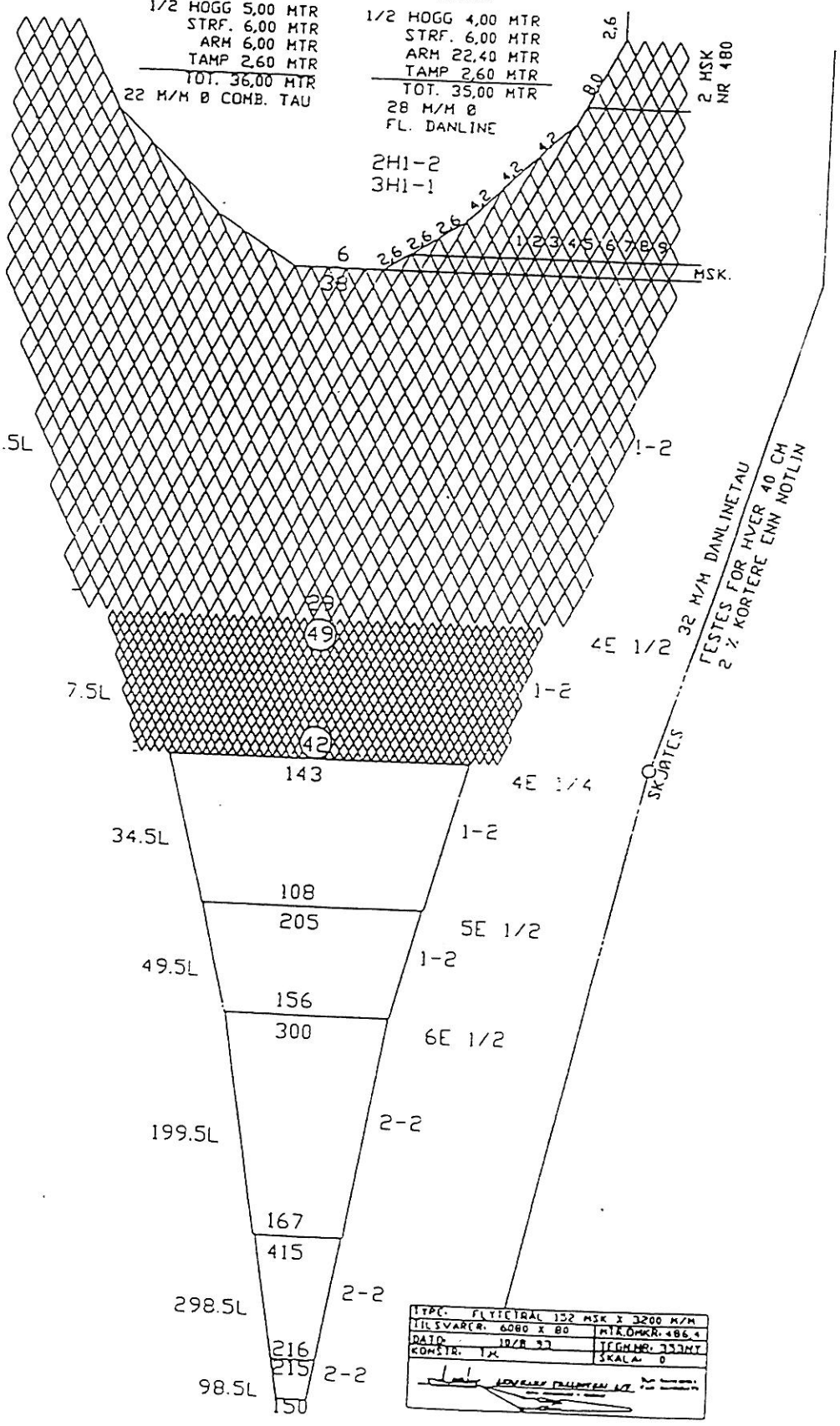
OVERDEL:
50 STK 11" PLASTKULER

UNDERDEL
14 M/M WIRE OMSP. MED
14 M/M BLYTAU
+ KJETTING.
TOTAL VEKT UNDER 400 KG.

1/2 HOGG 5,00 MTR
STRF. 6,00 MTR
ARM 6,00 MTR
TAMP 2,60 MTR
TOT. 36,00 MTR
22 M/M Ø COMB. TAU

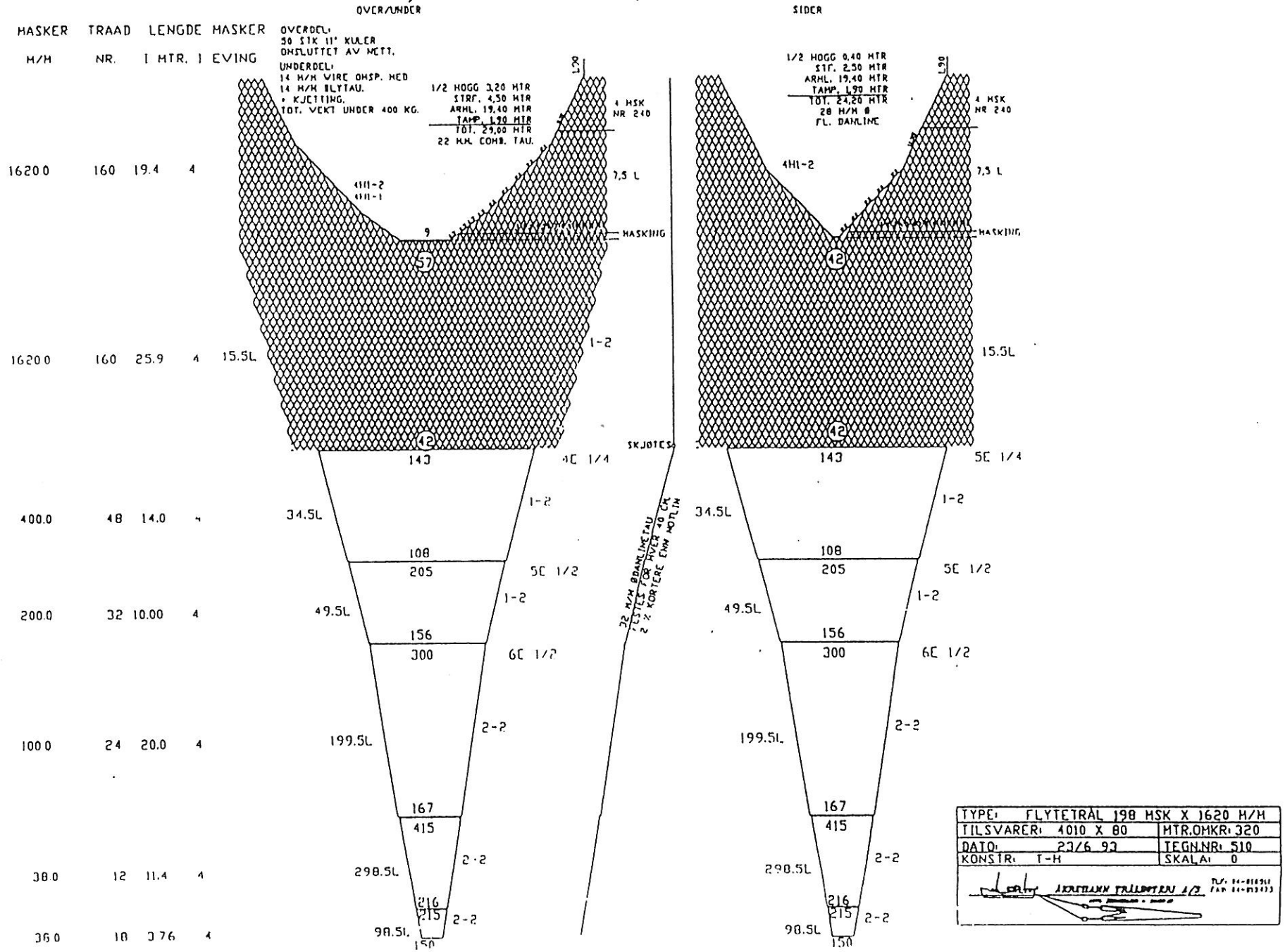
SIDER.
1/2 HOGG 4,00 MTR
STRF. 6,00 MTR
ARM 22,40 MTR
TAMP 2,60 MTR
TOT. 35,00 MTR
28 M/M Ø
FL. DANLINE

MASKER M/M	TRAAD NR.	LENGDE MASKER I MTR.	I EVING	
3200.0	240	22.4	4	
3200.0	240	32.0	4	9.5L
1620.0	160	13.0	4	7.5L
400.0	48	14.0	4	34.5L
200.0	32	10.00	4	49.5L
100.0	24	20.0	4	199.5L
38.0	12	11.4	4	298.5L
38.0	18	3.76	4	98.5L

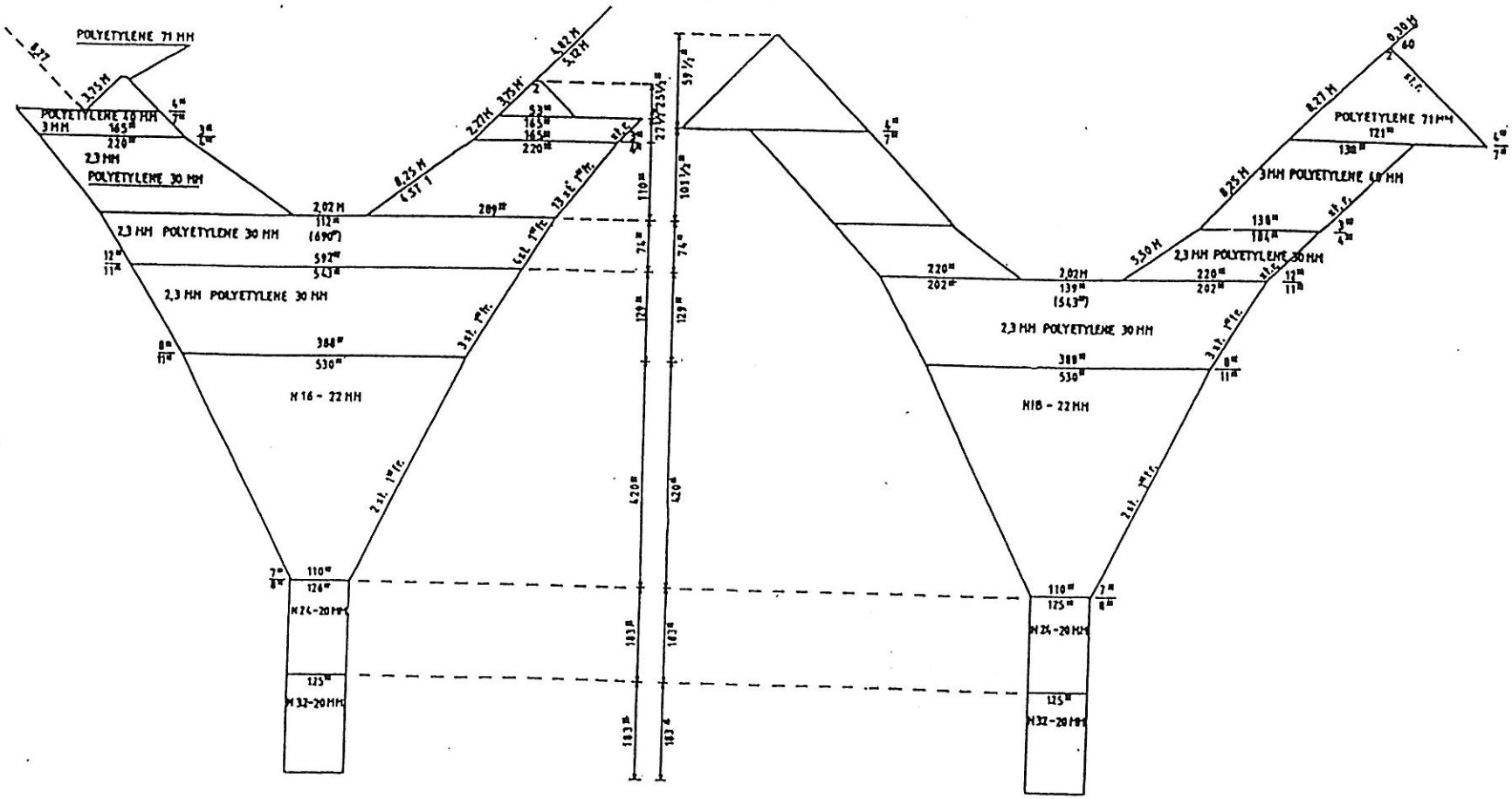


TYPE: FLYTETRÅL 132 MSK X 3200 M/M	
TILSVARER: 6080 X 80	MTR.OMKR. 486,4
DATO: 10/8 93	TEGN.NR: 7337MT
KONSTR: TM	SKALA: 0

F/F Dr. Fridtjof Nansen



Bottom trawl: High opening shrimp and fish trawl with net headline 31m (floatline), foot-rope 47m, gear with 12 cm diameter roller disks, 40 m sweeps, estimated headline hight 6m and distance between wings during towing 18-20m.



Annex V RV Welwitchia's gear mensuration

Objectives

The main objective of the cruise is to study the performances of the new Gisund bottom trawl net, supplied by Nansen Program, for RV Welwitschia rigged with Poly-Ice doors. The net is similar in construction to the one used by RV. Dr. Fridtjof Nansen, but its materials are lighter (see the attached drawing). The size of the net drum dictated the choice of lighter material on RV vessel Welwitschia. Similar nets for both RV vessels are essential when comparing trawl data collected by either vessel. Of particularly important, the objective aims at the followings:

- To observe the distance between wings during trawling
- To observe the distance between doors during trawling
- To measure the vertical opening of the net
- To measure the clearance of the ground gear from the seabed.

Methods:

Tests of the trawl performance of the new bottom net were conducted on 3rd to the 4th of May 1996. The observations were done in an area northwest of Conception Bay (23°37 S and 14°08 E) at a sea depth of about 200 m. The Scanmar RX 400 receiver and data processing unit were connected to the ship's hull mounted hydrophone. A standard VGA screen was used as a display unit. The performance of the new trawl during towing along the seabed was measured by attaching Scanmar sensors. Two sensors were fitted on the trawl: (1) the height sensor*, which shows the distance between the head-rope and foot-rope as well as the clearance between the foot-rope and the seabed; (2) the distance sensor, which measures the distance between the sensor and the mini-transponder.

In three hauls, the cod-end was left open. The distance sensor and mini-transponder were attached to the warp about two metres from the headline. The height sensor was fitted above the headline. The fourth haul was aimed at determining the distance between the trawl doors during towing. For this test, the sensor was placed approximately two metres in front of the doors. No restraining technique was used in any observations. The characteristics of the trawl doors are shown in Table I.

Table I. Poly Ice Bottom Trawl Door Characteristics.

Area	5.3 m^2
Dimensions	3 250 x 2 080 mm
Type	6 ½
Weight	1 300 kg

* HO/HC Telegram on height sensor

Results:
The results of the first observation are shown below (Table II). The mean distance between the wings was 23.2 ± 0.9 m. The mean vertical opening was 2.7 ± 0.3 m, while the average clearance of the ground-gear from the sea bed was 0.2 ± 0.1 m.

Table II. Scanmar measured values of the bottom net with cod-end open. Dimensions for distance between wings, vertical opening of the mouth, and clearance of foot-rope.

Time	Depth	Distance	Opening	Clearance
4.26	199	23.5	3.7	0.1
4.28	199	23.9	2.9	0.1
4.3	199	23.6	2.8	0.1
4.32	199	23.3	2.7	0.3
4.34	198	23.4	2.7	0.3
4.36	198	23.2	2.7	0.2
4.38	197	23.1	2.6	0.4
4.4	198	23.2	2.6	0.1
4.42	197	23.1	2.6	0.2
4.44	197	23.2	2.6	0.2
4.46	197	23.1	2.6	0.2
4.48	197	23.1	2.6	0.2
4.5	197	23	2.6	0.2
4.52	197	22.8	2.6	0.2
4.56	197	22.9	2.6	0.1
Average	**197.73**	**23.23**	**2.73**	**0.19**
Stdev	**0.88**	**0.28**	**0.28**	**0.09**

Both measured characteristics seemed consistent, but different from those of RV Dr. Fridtjof Nansen (Table III). It must be pointed out however, that RV Nansen used the restraining technique of strapping of the warps.

Table III. Gear performance data of Dr. Fridtjof Nansen observed in January 1995

Door type	Door spread	Wing spread	Vertical opening
Thyboron	55 to 56 m	22 m	5 ± 0.3 m

Because of the low vertical opening of the net, and possible overspreading of wings, 26 floats were added to the float-line. The results are from adding the floats improved performance, and are shown in Table IV. The vertical opening increased from an average 2.8 m to an average of 4.6, an increase of about 62%. Similarly, the distance between the wings increased from an average of 23.2 m to 24.4 m, an increase of about 6%.

Table IV. Scanmar measurements of the trawl dimensions with 26 floats added.

Time	Depth	Distance	Opening	Clearance
7.4	202	23.8	4.7	0
7.42	202	24.1	4.5	0.1
7.44	203	24.1	4.4	0.2
7.5	203	23.8	4.6	0
7.52	203	23.7	4.1	0.8
7.54	203	23.6	4.5	0
7.58	203	23.4	4.8	0
8	203	23.4	4.6	0
8.02	203	23.4	4.6	0.3
8.06	203	23.2	4.6	0
8.08	203	23	4.1	0
8.12	203	23.4	4.5	0
8.14	203	23.2	4.6	0
8.16	203	23.1	4.8	0
8.18	203	23.1	4.8	0
8.2	203	23.1	4.9	0.1
8.22	203	22.9	5	0.5
8.24	203	22.9	5.1	0.1
Average	**202.89**	**23.40**	**4.62**	**0.12**
Stdev	**0.32**	**0.38**	**0.26**	**0.22**

The results of the measurements of the distance between the doors during towing are shown in Table V below.

Table V. Scanmar measurements of the distance between the doors, vertical opening and the clearance.

Time	Depth	Distance	Opening	Clearance
931	203	60.1	5.6	0.1
9.32	203	62.3	4.7	0.1
9.34	203	60.1	3.9	0.1
9.36	203	62.7	3.9	0.1
9.38	203		3.2	0.2
9.4	203		3.3	0.2
9.42	203		3.3	0.2
9.44	203		3.2	0.1
9.46	203		3.3	0.1
Average	**203**	**61.30**	**3.82**	**0.13**
Stdev	**0**	**1.40**	**0.83**	**0.05**

During the observation, the distance sensor relayed only the information during the first five minutes after a touchdown. The average distance measured between doors was 61.3 ±1.4 m, while the vertical opening of the net reduced to 3.8 ±0.8 m. This is surprising considering that no other change in the rig was made to the trawl.

The last observation was to test the behaviour of the trawl with the cod-end closed. The tow was limited to 10 minutes in duration due to systematic reduction of the vertical opening from 5.1 to 2.1 m during the tow (Table VI). The mean distance measured between the wings was similar to the previous three observations.

Table VI. Scanmar measurements of the trawl characteristics with the cod-end closed

Time	Depth	Distance	Opening	Clearance
10.43	200	23.9	5.1	0.1
10.44	200	24.1	4.7	0
10.46	200	23.9	3.9	0.4
10.48	200	23.7	3.7	0.4
10.5	200	23.6	3.1	0.9
10.53	200	23.4	2.1	2.1
Average	**200**	**23.77**	**3.77**	**0.65**
Stdev	**0**	**0.25**	**1.09**	**0.78**

The catch was estimated at 2.0 tons: 1500 kg of horse mackerel (mean total length 23 cm), and the rest, two years' old hake. It is probable that as the net was filling, the increasing weight of catch caused the vertical opening to reduce.

More tests were planned, but the net was torn along the belly during hauling. The probable cause of the severe damage was that the cod-end became stuck at the stern ramp while it was pulled in.

Remarks:

Below are my personal remarks from the observation of the trawl gear. We have to solicit advice from specialists in the field of gear technology.

- The net fits the drum of the vessel
- No serious problem of catch selectivity has been observed
- Lines must be fitted to support the belly of the net and protect the finer netting material in that part.
- Poly-Ice doors seem oversized for this trawl-net
- Possibly Type 6 doors, may be suitable, but they need to be tested and monitored during trawling.
- Installation of Scanmar equipment to measure trawl performance should receive a high priority